DOCTOR OF PHILOSOPHY

Periodontal disease and oral health-related quality of life smoking cessation adventures in primary dental care

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Periodontal disease and oral health-related quality of life: smoking cessation adventures in primary dental care

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Periodontal disease

and oral health-related quality of life:

Smoking cessation adventures in primary dental care

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To the Faculty of Medicine, Dentistry and Nursing by
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Declaration

I declare that I am the author of this thesis and have consulted all references cited. I have carried out the work of which this thesis is a record. This work has not been previously accepted for a higher degree.

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Abstract

Much of the workload of primary dental care teams in remote-rural Scotland consists of treating periodontal disease, an inflammatory condition for which smoking is a proven risk factor.

This thesis sought to ascertain the effectiveness of a smoking cessation intervention applied in a primary care dental setting and employed a narrative literature review to explore periodontal disease, smoking and smoking cessation interventions. This literature review informed the design of a randomised controlled trial which failed due to lack of recruitment.

The Medical Research Council Framework for the Development and Evaluation of Complex Interventions was employed to provide structure to the modelling of a feasibility trial likely to succeed in evaluating the benefit of smoking cessation provision in rural dental settings.

A systematic literature review was undertaken to evaluate evidence regarding prevalence of periodontal disease, tobacco use and the effectiveness of tobacco cessation interventions applied in remote-rural areas. This identified a dearth of robust evidence particularly in relation to smoked tobacco. In order to model a feasibility study better adapted to the current study population, a prevalence study exploring the smoking attitudes and behaviours, the oral health-related quality of life and periodontal status of 398 dental patients was undertaken at the two study locations.

Twenty three percent of the participants were found to be smokers and periodontal health was significantly poorer in those who smoked. Both smokers and non-smokers strongly agreed that dentists should be involved in provision of smoking cessation activities.

The willingness of smokers to quit was not related to the degree of periodontal disease they experienced, suggesting that periodontal health is not valued sufficiently to factor into a decision to stop smoking. However periodontal health and smoking status both impacted greatly on oral health-related quality of life.

It is recommended that a feasibility trial be undertaken in remote-rural primary dental care of a smoking cessation intervention which forms an integral part of periodontal care and focuses on improving quality of life parameters rather than periodontal measures.

Chapter 1: Introduction

The work for this thesis was conducted within the Argyll & Bute Community Health Partnership (CHP), which has a population of 91,000, and is in an area categorised as remote-rural according to the Scottish Government's 6-Fold Urban Rural Classification definition of being more than 30 minutes drive time from the nearest settlement with a population of 10,000 or over (Scottish Government 2009 -2010). Its economy is service-based with a high proportion of its population employed in health, education, agriculture, fishing and tourism.

This thesis was undertaken in the dental departments of the Mid Argyll Community Hospital and Integrated Care Centre in Lochgilphead, and Cowal Community Hospital in Dunoon. Lochgilphead and Dunoon are small towns with populations of 2,300 and 8,200 respectively. Figure 1.1 on page 4 shows the location of Argyll & Bute CHP within Scotland, as well as the locations of Lochgilphead and Dunoon within the CHP. The primary dental care practices in each site comprise three dental surgeries and operate under the auspices of the Salaried Primary Care Dental Services of Argyll & Bute CHP. The presence of Salaried rather than Independent general dental practices reflects the difficulty of recruiting healthcare professionals, including dental professionals, to remote and rural areas (Skillman et al. 2010; Richards et al. 2005).

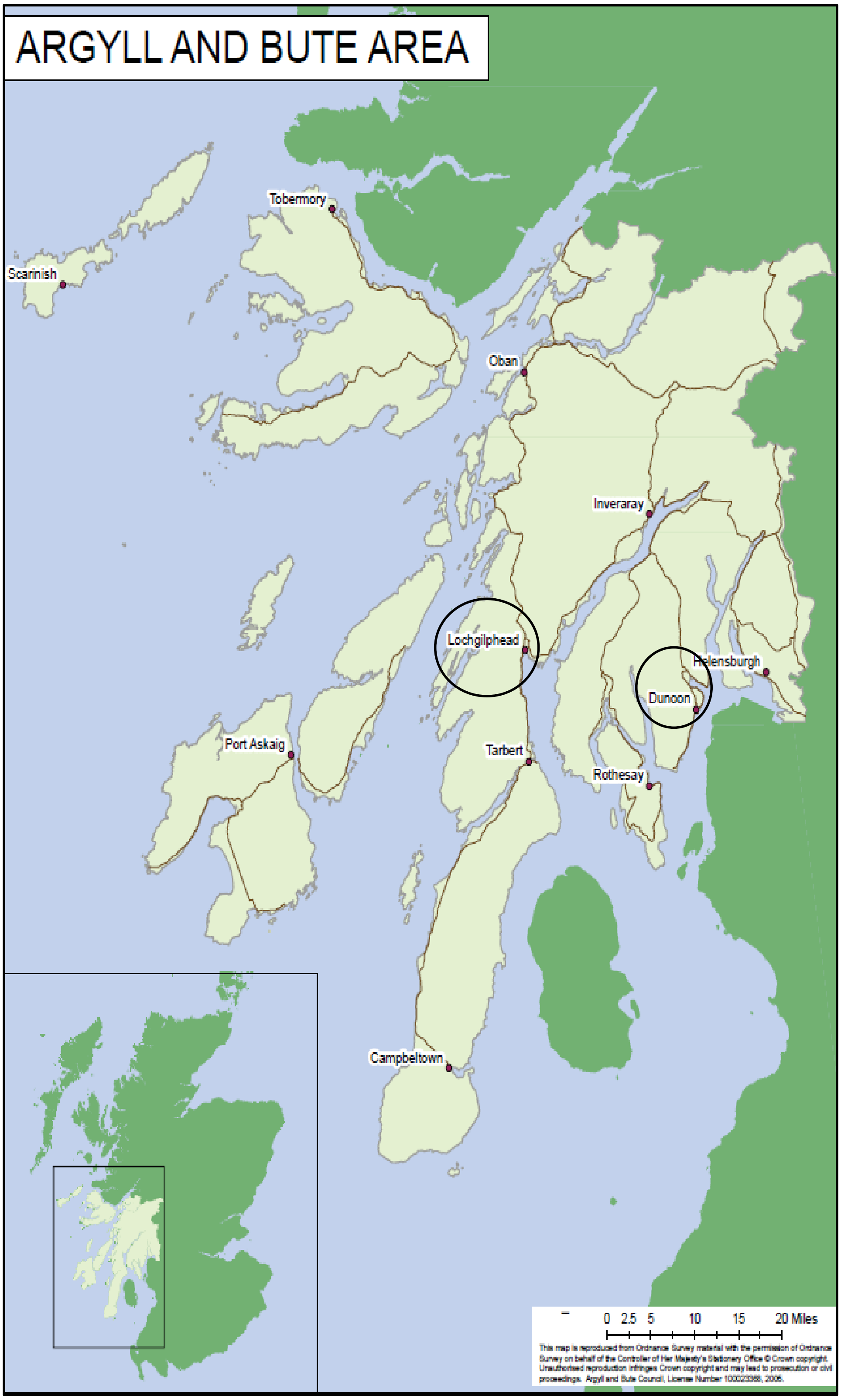
The majority of the dental care required by the population of patients attending these dental practices related to chronic periodontitis, which seemed to be particularly prevalent amongst smokers. Therefore, when an opportunity arose to undertake a research project under the auspices of the University of Dundee, with funding provided by a Remote and Rural Fellowship from NHS Education Scotland, the potential role of the dental team in improving periodontal health as a result of encouraging smoking cessation seemed the obvious subject to explore.

Providing healthcare in remote and rural areas presents specific problems of accessibility. Geographical remoteness increases travelling times to reach healthcare services, and public transport may not be available. Higher levels of poverty are often found in rural areas which may also make travelling more difficult and support systems less well-developed (Cramp 2006). It may be necessary to tailor healthcare interventions to suit the challenges of meeting the healthcare needs of a rural population (Skillman et al. 2010).

Chronic periodontitis is a multifactorial disease which arises as a result of the host inflammatory response to the presence of a biofilm containing plaque bacteria. The inflammatory reaction can result in progressive, sporadic destruction of the periodontal ligament and bony support of the teeth (Socransky et al. 1998; Page and Kornman 1997). Increasing mobility and loss of the tooth can occur if the plaque biofilm is not disturbed by toothbrushing and other oral hygiene measures (Schaltze et al. 2004).

Chronic periodontitis in its mild form is almost endemic across the world (Baelum and Lopez 2013; Kinane et al. 2005). Moderate periodontal disease was found in 45% of adults in the UK in 2009 (ADHS 2009) and a global prevalence of severe chronic periodontitis of between 5% and15% has been found (Slots 2013).

Figure 1.1: Location of Lochgilphead, Dunoon and Argyll & Bute CHP



The global burden of disease represented by chronic periodontitis is verified by its position as the sixth most prevalent disease (Marcenes et al. 2013). However, periodontal disease also presents the individual with a disease burden, since it has been shown to impact negatively upon an individual's oral health-related quality of life (Nagarajan and Chandra 2012; White et al. 2011; Berbnabe and Marcenes 2010; Jowett et al. 2009; Sanders et al. 2009; Slade et al. 2005).

With regard to aetiology, smoking has been identified as one of the most significant causative factors in chronic periodontitis (Javed et al. 2012; Patel et al. 2012; Hanioka et al. 2011). The prevalence of smoking in the UK has decreased from a high of over 60% of men and over 40% of women smoking in the 1960s, to around 28% of men and 26% of women in the year 2000 (WHO 2011). The prevalence of tobacco smoking in Argyll & Bute CHP is 22%, slightly below the Scottish average of 23% in 2011 (Scottish Household Survey 2011). However, the rates of smoking tobacco in Scotland have stopped declining, suggesting that those individuals who still smoke are more deeply entrenched in their smoking habit and find it difficult to stop (ASH Scotland 2013). Research suggests that the majority of these 'hard-core' smokers would like to quit, however, of the 33% who attempt to quit each year, only 2% succeed (Beaglehole and Watt 2004; NICE 2006; Health Scotland and ASH Scotland 2010) due largely to the highly addictive nature of nicotine.

These disappointing results with regard to quit rates are at odds with the smoking cessation services which have been available throughout Scotland since 2004 when "A Breath of Fresh Air for Scotland" (Scottish Executive 2004) was first launched. Smoking cessation services across Scotland provide interventions combining pharmacological and behavioural support, which have improved quit rates at six months to 13–19% as opposed to 2-8% for pharmacological support alone and 7% for behavioural support alone (Stead and Lancaster 2012; NHS Health Scotland and ASH Scotland 2010; NICE 2007; Silagy et al. 2004; West et al. 2000).

The Smoking Cessation Guidelines for Scotland (2004) and the NICE Guidelines (2006) state that all healthcare professionals, including dental professionals, must determine their patient's smoking status, advise them to quit and assess their readiness to quit. If patients are interested in quitting they should either be assisted to quit or be referred to specialist smoking cessation services (NICE 2006; NHS Health Scotland 2004). Despite this guidance, smoking cessation activity in a dental setting appears limited (Gonseth et al. 2010; Binnie 2009; Brothwell and Armstrong 2004). Given the acknowledged access issues in provision of healthcare interventions in remote and rural areas, the integration of smoking cessation interventions into routine dental care could represent an even more effective proposition in remote and rural areas than in urban areas.

The above observations gave rise to the original aim of the thesis, which was to determine whether an additional benefit in terms of quit status and periodontal health could be achieved by an intensive smoking cessation intervention compared with a brief smoking cessation intervention in primary dental care for patients residing in a remote and rural area in Scotland. The study designed was a randomised controlled trial, parallel-group study: **P**eriodontal **H**ealth **a**nd **S**moking **Ce**ssation (PHaSCe) trial.

Despite 16 months recruitment to the PHaSCe trial recruitment rates were extremely disappointing, with only 14 patients agreeing to participate of whom 3 fulfilled the inclusion criteria. It seemed impossible to continue with PHaSCe, and it was necessary to consider the reasons for failure and make recommendations for the way forward. Important lessons were learnt which included a lack of systematic review of the available evidence as well as the need to model the characteristics of a smoking cessation intervention for primary dental care in remote-rural areas. This permitted the careful examination of the MRC Framework for Complex Interventions (2010) (Figure 2.5). The MRC Framework for Complex Interventions showed clearly the mistakes that had occurred with regard to the development of the intervention and consequently the PHaSCe trial. With this in mind, it was decided to populate the first aspect of the MRC Framework for Complex Interventions and undertake systematic review and meta-analysis of the evidence underpinning the effectiveness of tobacco cessation interventions provided by dental health professionals in remote and rural primary dental care followed by the collection of patient data regarding smoking status and periodontal health from those attending two general dental practices in remote and rural areas. The information gathered via the systematic literature review and the cross-sectional survey would be used to model a feasibility trial to inform a randomised controlled trial for smoking cessation provided by dental health professionals in remote and rural primary dental care.

This thesis is therefore in several parts and constitutes the journey taken by KE in her adventures in smoking cessation in primary dental care.

The first part consists of a narrative literature review (Chapter 2) which examines chronic periodontitis and its prevalence, pathogenesis, risk factors and impact on quality of life. It explores the prevalence and health impacts of smoking, and the role of dental professionals in supporting smokers to quit. The PHaSCe trial which aimed to examine the effectiveness of an intensive smoking cessation intervention applied in the dental surgery compared with an intensive smoking cessation intervention applied in NHS specialist stop smoking services in a remote and rural area to promote periodontal health, together with the findings and recommendations are presented.

The second part is based on the MRC Framework for Complex Interventions to allow the modelling of a feasibility trial to inform a randomised controlled trial for smoking cessation provided by dental health professionals in remote and rural primary dental care.

In Chapter 3 the systematic review queried: "How effective are tobacco cessation interventions applied by dental health professionals in remote and rural primary dental care?" This systematic review involved a rigorous and methodical search of the peer-reviewed and unpublished literature exploring any tobacco-related intervention with a dental or oral health related component undertaken in a rural area.

The survey of primary dental care patients is also presented in Chapter 3. This survey examined the prevalence of smoking and periodontal disease. It also assessed the participants' smoking-related knowledge, attitudes and behaviours as well as their oral health-related quality of life. Using structural equation modelling a model for a complex smoking cessation intervention in remote-rural primary dental care was formulated. This formulation suggested that smoking status and periodontal status had direct and significant relationships with oral health-related quality of life. Therefore it was proposed that an intervention focusing on oral health-related quality of life with elements relating to smoking cessation (behavioural and pharmacological) together with maintenance programmes for periodontal health could provide the basis for a feasibility study for a smoking cessation trial in remote-rural primary dental care in Scotland.

Chapter 4 presents the overall discussion and Chapter 5 presents the recommendations for a feasibility study for a smoking cessation trial in remote-rural primary dental care in Scotland.

Chapter 2:

The Periodontal Health and Smoking Cessation (PHaSCe) trial for primary dental care in remote-rural Scotland

2.1 Narrative literature review

2.2 Purpose of study

2.3 Method

2.4 Results

2.5 Discussion and reflections

2.6 Recommendations

2.0 Introduction

Periodontal disease is an inflammatory condition affecting the supporting tissues surrounding the teeth and presents in various forms, the most prevalent of which is chronic periodontitis. Despite its prevalence, most individuals are unaware of the presence of chronic periodontitis until it is well advanced, although in susceptible individuals it can rapidly progress to cause functional problems such as mobility of the teeth and tooth loss.

The aetiology of chronic periodontitis is complex with a variety of innate factors such as age, gender and genetic susceptibility. External factors such as socio-economic status, stress and alcohol consumption all playing their part. Smoking is one of the most important risk factors implicated in the development of chronic periodontitis and thus this study goes on to investigate chronic periodontitis in depth and its relationship to smoking in particular.

The study was undertaken in a remote and rural area, and aimed to determine the effectiveness of smoking cessation interventions provided in the dental setting in promoting periodontal health in the population attending primary dental care services in this area.

2.1 Chronic periodontitis and smoking: a narrative literature review

2.1.0 Introduction

This narrative literature review considers the condition known as “periodontal disease” with respect to its prevalence, pathogenesis, treatment and its links with systemic disease. The risk factors for periodontal disease are explored, as is the impact periodontal disease has on the quality of life of an individual. It particularly focuses on chronic periodontitis (see Section 2.1.2).

The narrative review goes on to examine the health impacts and prevalence of tobacco use. The introduction of tobacco control legislation, the development of specialist smoking cessation services and the behaviour change and addiction theories underpinning them are discussed.

The impact of tobacco smoking on periodontal health is explored, and a review of literature describing smoking-related research undertaken in a dental setting is presented.

2.1.1 The definition and classification of periodontal diseases

Periodontal disease is a term used to cover several inflammatory conditions associated with specific anatomical structures surrounding the teeth. These structures comprise the free and attached gingival tissues, the periodontal ligament and gingival connective tissue fibres and the alveolar bone (Schroeder 1997). Disease activity and progression occurs in the presence of a biofilm of microorganisms which can be found both above and below the gingival margin. This biofilm may calcify to form dental calculus (Jepsen et al. 2011).

An International Workshop for a Classification of Periodontal Diseases and Conditions which took place in 1999 developed the classification of periodontal conditions seen below and which is still currently in use (Armitage 1999):

I Gingival diseases

There are many conditions which affect the gingival tissues, the most common of which is gingivitis. Gingivitis is characterised by oedema and redness of the gingival margins associated with the presence of a plaque biofilm.

Gingival hyperplasia is characterised by thickening of the gingival tissues and its aetiology includes physical causes such as irritation by plaque or calculus or repeated trauma, and, pharmacological causes such as calcium channel blockers, anti-rejection medication for organ transplant patients and phenytoin, a medication used to treat epilepsy.

Hormonal imbalances such as occur during puberty and pregnancy can also affect the gingivae, as can viral infections such as herpes simplex and fungal infections e.g. generalised gingival candidosis. Mucocutaneous conditions such as lichen planus can also affect the gingival tissues, as can allergic reactions and trauma.

II Chronic periodontitis

Chronic periodontitis is defined as an inflammatory condition characterised by erythema and oedema of the gingival margins, along with destruction of the junctional epithelium and alveolar bone to form periodontal pockets. More detail regarding chronic periodontitis can be found in Section 2.1.3.

III Aggressive periodontitis

Aggressive periodontitis may be localised or generalised and is characterised by rapid bone loss around teeth giving vertical bony defects. Loss of supporting bone may lead to severe mobility or loss of teeth in people under 35 years of age, and this may happen with little plaque or calculus present.

IV Periodontitis as a manifestation of systemic disease

Periodontitis may result from some haematological conditions such as neutropenia or leukaemia, and may affect individuals with genetic disorders such as Downs syndrome or Papillon-Lefevre syndrome.

V Necrotizing periodontal diseases

Necrotizing ulcerative gingivitis and periodontitis is a painful condition characterised by loss of the interdental papillae with ulceration and necrosis. Submandibular lymphadenopathy can also be present, and a characteristic halitosis is noted. This condition is related to moderate and heavy smoking, and poor oral hygiene.

VI Abscesses of the periodontium

Periodontal abscesses form in periodontal pockets and the infection can be acute or chronic. They may be pain-free if they are draining from the pocket, and they can occur in vital teeth. They are characterised by swelling in the gingival sulcus and/or pus draining from the periodontal pocket.

VII Periodontitis associated with endodontic lesions

Periodontal abscesses can be found in association with endodontic abscesses and may present with swelling either apically or at any point in the periodontal pocket. It can be difficult to determine where the infection originated.

VIII Developmental or acquired deformities and conditions

Periodontal health can be affected by localised anatomical deformities such as an enlarged fraenum or lack of keratinised gingival tissue.

2.1.2 Chronic periodontitis

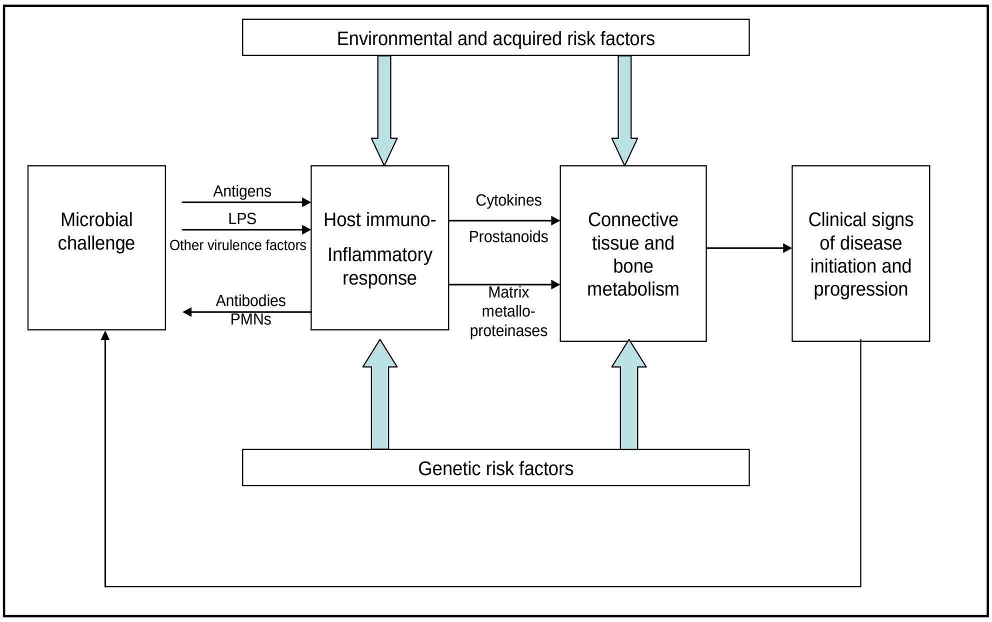
Chronic periodontitis is usually a slowly-progressing condition and whilst it is plaque-related, individuals demonstrate markedly different disease responses to similar levels of dental plaque (British Society of Periodontology 2011). Chronic periodontitis exhibits a genetic component with family members often showing similar susceptibility (American Academy of Periodontology 2000).

This section will examine the pathogenesis, prevalence, global burden and oral health impacts of chronic periodontitis as well as the risk factors for chronic periodontitis.

2.1.2.1 Pathogenesis of chronic periodontitis

At the pathogenesis level, chronic periodontitis is viewed as a chronic inflammatory condition resulting from a complex interaction between plaque biofilm and host response. The clinical features of chronic periodontitis include inflammatory changes in the gingival and periodontal tissues resulting in capillary proliferation, increased capillary and tissue fragility, destruction of connective tissue attachment and the subsequent loss of alveolar bone. Clinical observations as a result of these changes comprise increased redness of tissues with a tendency to bleed as a result of minor trauma, formation of periodontal pockets and bone loss with or without associated gingival recession and exposure of the root surface. Ultimately, the tooth may exhibit increased mobility, which can lead to its drifting and possible exfoliation with or without associated acute exacerbation or abscess formation (Schaltze et al. 2004).

Figure 2.1: Model for the pathogenesis of human periodontitis (Page and Kornman 1997)



Page and Kornman (1997) developed the model of pathogenesis of human periodontitis shown in Figure 2.1 which shows the multifactorial nature of periodontal disease and that conflicting processes are at play which, whilst in biological balance, maintain periodontal health, but disruption to any of the component factors can lead to disease. The microbial challenge occurs in the presence of a plaque biofilm which can become established if not disturbed by oral hygiene measures. Salivary mucins and proteins adhere to the tooth surface forming an acquired pellicle, which increases the adherence of bacteria. As the biofilm becomes thicker oxygen levels decrease at the base allowing the proliferation of anaerobic species of bacteria (Socransky et al. 1998). In chronic periodontitis higher proportions of gram-negative species are found, but pathogens are also found at healthy sites (Socransky and Haffajee 1992). This is discussed further in the section examining risk factors for chronic periodontitis.

The host response to the microbial challenge combines innate and adaptive immune responses (Genco 1992). Innate immunity involves the protective presence of saliva and an intact gingival epithelium. Bacteria produce lipopolysaccharides and other antigens resulting in the gingival tissues releasing antibodies and neutrophils which can cause non-specific tissue damage. Adaptive immunity occurs in response to specific bacterial antigens resulting in cytokines being released. These activate T and B cells and their activity can lead to periodontal tissue destruction. Gingival crevicular fluid produces increasing levels of antibodies such as IgG, IgA and IgM in response to specific plaque antigens (Landi et al. 1997). The host response both protects and damages periodontal tissues and the balance between these responses determines whether health is maintained or destruction of the periodontal tissues results Ebersole et al. 2001).

There are two main theories for the initiation and progression of chronic periodontitis. In the longitudinal model (Loe et al. 1965) it is hypothesised that the presence of plaque leads to gingivitis with associated gingival hypertrophy enhancing plaque collection below the gingival margin. This subgingival plaque may calcify to form dental calculus thus further enhancing plaque collection. The host inflammatory response to plaque collection results in localised chemical breakdown of the connective tissue attachment of the periodontium and pocket formation. The connective tissue attachment between the tooth and alveolar bone provides the stimulus required for localised bone turnover. Loss of this attachment therefore ultimately results in alveolar bone loss. This continues if untreated until the tooth becomes progressively mobile and is shed (Lindhe et al. 1975). This model proposes a slow, gradual, linear progression from mild to severe disease.

However, studies have shown that it is not the case that all gingivitis progresses to destructive periodontal disease (Baelum et al. 1988). A review of the literature by Kinane and Attstrom (2005) found that gingivitis and periodontitis are in fact stages of the same disease and host susceptibility may explain the differences in progression at different tooth sites and in different individuals.

Earlier, in 1984, Socransky et al. examined the data from longitudinal studies and proposed that chronic periodontitis progressed in “bursts” with periods of exacerbation and remission. These episodes could be related to the pathogens present at the site or to changes in the host susceptibility. This explanation of bursts of periodontal disease is supported by Flemmig (1993).

Flemmig (1999) suggested that chronic periodontitis tended towards a mainly longitudinal model with the possibility of an occasional episode of relatively rapid deterioration. Current thinking proposes that chronic periodontitis is cyclical in nature with some sites in the mouth progressing in a linear fashion whilst others are improving or deteriorating (Gilthorpe et al. 2003).

2.1.2.2 Prevalence, global burden and impact of chronic periodontitis

Chronic periodontitis is the most common form of periodontal disease and is almost universal in adults in its mild form i.e. where gingival inflammation and periodontal attachment loss of 1 – 2 mm are present at one or more sites (Baelum and Lopez 2013; Kinane and Attstrom 2005). Early studies measuring the prevalence of chronic periodontitis found that its prevalence increased with age and, that by the age of 40 years, destructive periodontal disease affected the majority of people (van der Velden 1984; Scherp 1964). These findings were based on whether an individual was disease free or not, but did not indicate the extent or severity of the disease. As the clinical symptoms of chronic periodontitis vary from site to site in the mouth as well as between individuals and populations, studies in the 1980s began to report the extent and severity of periodontitis (Baelum et al. 1986).

Recent studies of large populations from diverse geographical areas have found that, in industrialised countries, 10 – 15% of the adult population have severe periodontitis and that the prevalence increases with age until subjects reach 50-

60 years of age (Petersen and Ogawa 2005). It is thought that the decrease after this age is due to tooth loss among older age groups.

The global prevalence of advanced periodontitis is 5 – 15%, with limited variation across countries with highly differing income levels and ethnic groups (Slots 2013). Studies in the UK have shown that in 35 – 44 year old subjects, 54% have at least one shallow periodontal pocket and 13% have deep pocketing (Sheiham and Netuveli 2002). The 2009 Adult Dental Health Survey demonstrated that 45% of adults in the UK presented with periodontal pocketing of 4 mm or more (NHS Information Centre for Health and Social Care 2009). This demonstrates an improving picture of periodontal health as figures from 1988 and 1998 were 75% and 59% respectively (Dye 2012).

Whilst it is difficult to determine the exact reason for tooth extraction retrospectively, the number of teeth lost must be considered when assessing prevalence of chronic periodontitis as teeth which have been extracted are likely to have been the most severely affected (Gilbert et al 2005).

Global Burden of Periodontal Disease

The Global Burden of Disease (GBD) 1990 Study (Murray and Lopez 1997; World Bank 1993) measured the global burden of disease across the world using Disability-Adjusted Life-Years (DALYs) and Years Lived with a Disability (YLDs). It included three oral health diseases; untreated caries, severe periodontitis and tooth loss. The GBD study was repeated in 2010 allowing comparison across different regions of the world and over time (Murray et al. 2012).

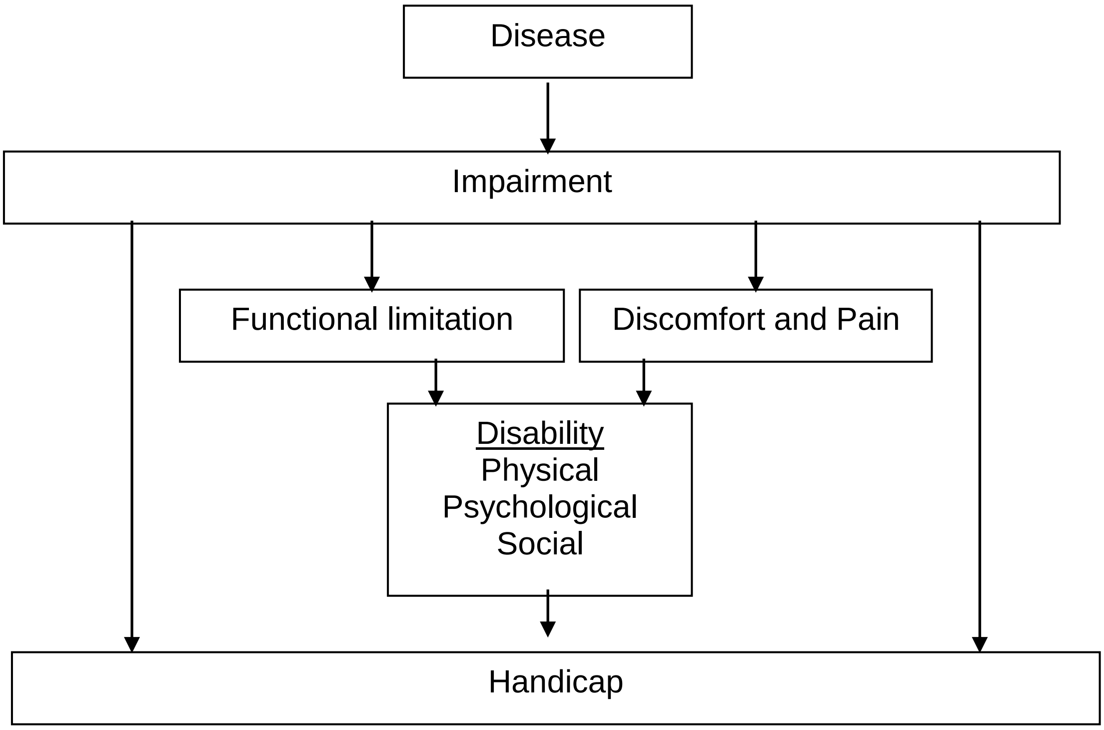
Marcenes et al. (2013) analysed the data collected in both GBD 1990 and GBD 2010 with respect to oral diseases. Of the 291 diseases included in the 2010 GBD study, the most prevalent of all was untreated caries in permanent teeth, whilst severe periodontitis was sixth most prevalent, and tooth loss thirty-sixth. This equates to a huge global burden due to oral diseases, with almost 2% of all YLDs attributable to them. An increase was found in DALYs associated with severe periodontitis between 1990 and 2010 but this was mostly due to population growth and aging rather than increased severity at an individual level. The rise did not occur evenly throughout the world, and in fact severe chronic periodontitis compared with moderate or mild chronic periodontitis was more prevalent than untreated caries in Australasia, Sub-Saharan Africa, many parts of Asia and Latin America. The burden of disease caused by severe chronic periodontitis was found to be comparable to cardiovascular disease, mental illness and blood dyscrasias (Marcenes et al. 2013).

Oral Health-related Quality of Life

While the biomedical model of health tends to concentrate on physical measurements such as clinical attachment loss an alternative way of considering the effects of chronic periodontitis is in the impact it has on the oral health and wellbeing of the person affected (Allen 2003). In 1980 the World Health Organisation produced a classification of impairment, disability and handicap which described the interlinking nature of biological, behavioural and psychosocial impacts of disease (World Health Organization 1980).

Locker (1988) developed his conceptual model for measuring oral health, based on the World Health Organisation classification (see Figure 2.2). This model described the mechanisms by which impairment such as the loss of a tooth might produce functional limitation or discomfort and pain leading to physical, social or psychological disability and thus handicap.

Figure 2.2: Locker's conceptual model for measuring oral health



A variety of tools have been developed and validated to measure the impact of oral health on the quality of daily living of an individual. The General Oral Health Assessment Index (GOHAI) was developed in 1990 by Aitchison and Dolan. Originally, this index was designed to measure patient-reported oral functional problems in older people and was known as the Geriatric Oral Health Assessment Index. It has since been validated for use in younger age groups too, hence the name change. The GOHAI comprises 12 questions answered using a six-point Likert scale covering physical function, psychosocial function and pain or discomfort (Atchison and Dolan 1990).

The UK Oral Health-Related Quality of Life Measure (OHQOL-UK) aims to measure both the impact and the effect of poor oral health on quality of life (McGrath and Bedi 2001). The index correlates well with both self-reported and actual oral health status and is thus a reliable and valid measure of oral health-related quality of life.

Leao and Sheiham (1995) developed the Oral Impact on Daily Living Index, which examined the severity of the oral impacts identified by the Oral Health Impact Profile described in the following paragraph. Further development of this model has resulted in the Oral Impacts on Daily Performance (OIDP) which focuses on the disability and handicap concepts of Locker’s conceptual model (Adulyanon and Sheiham 1997). The OIDP index assesses the severity of impacts with respect to nine daily tasks: eating, speaking, cleaning teeth or dentures, going out, relaxing, including sleeping, smiling, laughing and showing teeth without embarrassment, carrying out major role or work, emotional instability, for example becoming more easily upset than usual and enjoying contact with other people such as friends, relatives and neighbours.

Slade and Spencer (1994) developed the Oral Health Impact Profile (OHIP) which consisted of a series of forty nine questions covering seven dimensions of impact of oral health; functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and pain. Its advantages over other scales are that the statements were developed by dental patients rather than researchers and it can be used to measure both frequency and severity of impacts. It employs a Likert response format where 0=never, 1=hardly ever, 2=occasionally, 3=fairly often and 4=very often.

A shortened version of the OHIP questionnaire was developed using regression analysis in 1997 and this reduced the number of statements to 14. The OHIP-14, as the smaller version is known, contained questions from each of the theoretical domains in the original (Slade 1997). It has been shown to be valid and reliable across many different populations and in several languages.

Similar results have been found in impacts of oral disorders on populations across the developed world with 16% of participants in surveys in both the United States and Australia experiencing at least one impact fairly often or very often. Impacts on daily living related to oral disorders were more prevalent amongst disadvantaged groups (Sanders et al. 2009). A survey conducted in Australia and the United Kingdom found that 18.2% of Australians experienced impacts fairly often or very often as compared with 15.9% of UK participants. Variation was found between the four countries of the United Kingdom, with 19.8% of participants in Scotland demonstrating impacts fairly often or very often as opposed to 13.6% in Wales. The degree to which oral diseases impact on quality of life are most associated with tooth loss and socio-economic status in this study (Slade et al. 2005).

The Adult Dental Health Survey undertaken in 2009 in England, Wales and Northern Ireland used both the OHIP-14 and OIDP indices to measure the impact of oral health and the severity of those impacts on daily living in the population surveyed (Nuttall et al. 2011). The OHIP-14 demonstrated that 29% of those with no untreated caries had experienced pain in the last 12 months, a proportion of which would result from periodontal disease. Forty six percent of individuals presenting with periodontal pocketing of 6mm or more had at least one oral impact as compared with 35% of those without pocketing. Dentate adults with poor periodontal health were shown to have more oral impacts, and more severe impacts on daily performance, than those with better periodontal health. Bernabe and Marcenes (2010) analysed the data from the Adult Dental Health Survey and proved that periodontal disease is associated with poor quality of life after taking demographic, socioeconomic and other clinical variables into account.

Few studies have looked at quality of life issues specifically associated with periodontal disease and most that have evaluated specific patient groups e.g. pregnant women (Wandera et al. 2009), patients undergoing haemodialysis (Guzeldemir et al. 2009) or postoperative periodontal patients (Ozcelik et al. 2007). Zhou et al. (2010) found that poor periodontal health was significantly related to low oral health-related quality of life in a population of hospital inpatients with chronic obstructive pulmonary disease.

A study which examined the oral health related quality of life of passengers and crew on a cruise ship (Sobotta 2006) found significant levels of periodontal disease, but low impact, in both passengers and crew. This may have been explained in part by the immediate availability of dental care when required, and may have been related to the stress-free holiday environment the passengers were enjoying but this was unlikely to explain the low impact of periodontal disease on the crew.

Jowett et al. (2009) investigated the oral health related quality of life in patients with chronic periodontal disease and found that it was worse than in people with good periodontal health. They also found that routine non-surgical periodontal treatment was successful in minimising poor oral health related quality of life. It is clear that the impact of disease on an individual's quality of life is dependent not only on the extent of the condition, but also on their perception of how much disability it causes (Allen 2003).

Nagarajan and Chandra (2012) divided a population of patients with chronic periodontitis into three groups according to their periodontal risk and assessed their oral health-related quality of life before and after non-surgical periodontal treatment. They found that oral health-related quality of life improved in those with moderate or high periodontal disease risk following periodontal therapy, and that there was a highly significant negative impact on quality of life associated with high risk for chronic periodontitis as opposed to low or moderate risk (Nagarajan and Chandra 2012).

In summary, mild and moderate chronic periodontitis affects between 70% and 85% of the population and ranges in its intensity. Work from Marcenes and colleagues (2013) has shown that chronic periodontitis in its most severe form is the sixth most prevalent condition regarding global burden of disease. Moreover, the impact of chronic periodontitis has been explained with regard to oral health-related quality of life suggesting and supporting the view of Bernabe and Marcenes (2010) that this periodontal condition impacts on people's quality of life.

Measurement of chronic periodontitis

The ability to compare results between studies of the prevalence of chronic periodontitis is limited as there is no definitive measure of the severity of periodontal disease, or of the preferred method for measuring periodontitis (Papapanou and Lindhe 2008). The majority of studies measuring periodontal disease will use some combination of a plaque index, bleeding index, tooth mobility index, pocket depth measurement or clinical attachment loss measurement.

- Plaque indices

An overview of plaque indices cited in academic papers illustrates the breadth of measures available. They range from simply running a probe around the gingival margin to determine the presence or absence of plaque (O'Leary et al. 1972), to technologically sophisticated methods such as fluorescence camera imaging (Raggio et al. 2009). Some plaque indices require staining of the plaque prior to scoring e.g. the Visible Plaque Index (Turesky 1970), the Modified Navy Index (Elliott et al. 1972), and the Ekstrand Index (Ekstrand et al. 1998). Other plaque indices such as the Oral Hygiene Index (Greene and Vermillion 1964) and the Plaque Index (Silness and Loe 1964) rely on running a probe around the gingival margin to determine the quantity of plaque present. Some of the indices measure the thickness of plaque and others the distribution, and others give greater weight to some sites on the tooth e.g. in the gingival third of the tooth. It can be seen that this plethora of indices makes comparison of studies very difficult (Raggio et al. 2010).

Eaton et al. (1997), using the dichotomous Plaque Index, demonstrated that reliable results can be achieved in primary care by inexperienced examiners. They also showed that, with regular checks, it is possible to maintain intra- and inter-examiner reliability over a period of twelve months which is comparable to the duration of data collection in this current study. Galgut (1999) has demonstrated that a dichotomous scale i.e. 0 = absence of plaque and 1= presence of plaque consistently shows lower levels of plaque than an ordinal scale but the differences are small.

- Pocket depth and clinical attachment loss

A similar picture is found when comparing papers discussing the severity of periodontal disease, as differing methods of measurement are employed and different thresholds used to indicate whether disease is present, and if so, if it is mild, moderate or severe (Kingman and Albandar 2002; Papapanou 1996).

Periodontal pocket depth is defined as the distance from the gingival margin to the bottom of the pocket using a periodontal probe held perpendicular to the long axis of the tooth and using a moderate force of 15 – 20 grams. Clinical attachment loss is measured using the periodontal probe in the same way but measures the distance from the cemento-enamel junction to the base of the pocket (Andrade et al. 2012; Papapanou and Lindhe 2008). Six measures are recorded for each tooth excluding third molars; mesial, central and distal on both buccal and lingual/palatal aspects, giving a possible total of 168 measurements for each individual. In order to simplify and reduce the time involved in data collection and analysis, some studies have used index teeth to represent the whole mouth rather than recording six measures of clinical attachment loss and pocket depth on each tooth (Dye and Thornton-Evans 2007). The number and site of index teeth varies between studies further reducing comparability (Susin et al 2005; Kingman and Albandar 2002). If a partial mouth design is employed then a percentage of examinations should examine the full mouth to provide a correction factor to compensate for any inaccuracies (Susin et al 2005).

The clinical attachment loss, pocket depth and gingival recession are all measured using a periodontal probe. However, there is no agreement on the type of probe used in periodontal research. Differences in the probe tip shape and diameter can cause significant differences in pocket depth recordings, as can the accuracy of markings on the probe, all of which makes comparison of results from different studies problematic (Savage et al. 2009).

- Consistency and reliability of measurement

The consistency of measurements achieved using periodontal probes can also be compromised by varying the angulation at which the probe is inserted in the pocket and the force used. In order to minimise errors of measurement the angle of insertion of the probe in this study was parallel to the long axis of the tooth at all times, although clinical factors such as difficult to reach teeth and poor angulation of teeth had to be overcome on occasions.

When using a conventional manual probe to measure probing depth it is possible to use varying amounts of force when probing thereby compromising the accuracy of the measurements. It has been determined that the ideal force required to reach the base of a periodontal pocket without causing any tissue damage is 20g (Leroy et al. 2010). Attempts have been to calibrate the force used when probing periodontal pockets using manual and electronic probes. Probes may be classified as follows (Grossi et al. 1996):

First generation:	Non-pressure controlled (manual) with visual data recording
Second generation:	Pressure controlled with visual recording
Third generation:	Pressure controlled with direct computer data capture

A systematic review examining the reproducibility of measurements using first, second and third generation periodontal probes failed to demonstrate significant differences (da Silva-Boghossian et al. 2008).

The largest source of data on the prevalence of periodontal disease in the United States is the National Health and Nutrition Examination Survey (NHANES), and this utilises a partial mouth periodontal examination. Eke et al. compared the prevalence of periodontal disease in 454 adults using both the partial mouth periodontal examination and a full mouth examination with six sites per tooth being examined. They found that their partial mouth periodontal examination routinely recorded only half the periodontal disease measured by the gold standard examination (Eke et al. 2010). This suggests that data gathered in other large scale epidemiological studies have underestimated periodontal disease prevalence.

Eke et al. (2010) identified seven different methodologies that had been used to define presence and severity of periodontal disease in national prevalence studies of periodontitis in the United States alone. Variations existed in the sites considered e.g. Page and Eke (2007), used the number of interproximal sites affected to determine severity, while e.g. Arbes et al. (2001), required a specific number of sites to be affected by a pre-determined level of clinical attachment loss, while still others e.g. Dye et al. 2007, used a dichotomised measure of a specified level of clinical attachment loss or pocket depth being present or absent.

The World Health Organisation developed the Community Periodontal Index (CPI) as a simple tool for assessing and comparing periodontal health status in countries across the world. It involves dividing the mouth into sextants and recording gingival bleeding, calculus and pocket depths at 6 sites on all teeth excluding third molars. The highest score found is assigned to each sextant as follows: CPI0 = periodontal health, CPI1 = gingival bleeding, CPI2 = gingival bleeding and calculus, CPI3 = periodontal pocketing of 4-5mm, and CPI4 = periodontal pocketing of 6 mm or over (World Health Organisation 1987). Data gathered from across the globe shows that periodontal disease affects a significant proportion of all populations wherever they live, with the proportion of the population experiencing mild (CPI2) and moderate (CPI3) periodontal disease ranging from 70% in the region of the Americas and the European Region, to 85% in the Western Pacific Region (Petersen and Ogawa 2005).

The British Society of Periodontology (2011) has further developed the Community Periodontal Index to provide a tool for assessing the periodontal treatment need of individuals attending dental practice known as the Basic Periodontal Examination. The scoring system used is shown in Table 2.1.

Table 2.1 Scoring codes for Basic Periodontal Examination (BPE)

0	No pockets >3.5mm, no calculus/overhangs, no bleeding after probing
1	No pockets >3.5mm, no calculus/overhangs, but bleeding after probing
2	No pockets >3.5mm, but supra- or subgingival calculus/overhangs
3	Probing depth 3.5-5.5mm
4	Probing depth > 5.5mm
*****	Furcation involvement

Radiographs have been found to provide a valid measure of the severity of periodontal disease by allowing the level of bony destruction and loss of lamina dura to be determined (Pitiphat et al. 2004). As with other methodologies for assessing the extent and severity of periodontal disease, there are no specific standards defined.

There is an urgent need for standardisation of indices engaged to determine the prevalence of periodontal diseases, and the parameters used to establish its extent and severity.

2.1.2.3 Risk factors for chronic periodontitis

Chronic periodontitis has a multifactorial aetiology and a variety of proven and proposed innate and external risk factors (Genco and Borgnakke 2013; Petersen and Ogawa 2013; Baelum and Lopez 2013; Hart et al. 2012; Watt and Petersen 2012; Irwin et al. 2007). These risk factors may be divided into categories relating to innate susceptibility e.g. genetics, and external behavioural factors e.g. smoking. The innate factors affecting periodontal disease are said to be age, gender, race/ethnicity and genetic susceptibility (Borrell and Talih 2012; Taba et al. 2012; Shiau and Reynolds 2010; Petersen and Ogawa 2005; Klinge and Norlund 2005; Jepsen et al 2003; Sheiham and Netuveli 2002).

For the purposes of this section of the review, the aetiological factors will be presented as follows: demographic factors, genetic factors, pathogens, socio-economic status, medical conditions and psychosocial factors including psychological stress, alcohol and smoking.

Demographic factors

- Age

Studies (Sheiham and Netuveli 2002; Petersen and Ogawa 2005;) have shown that an increased loss of gingival attachment with age, but this may be due to an increased exposure to other innate and external risk factors alongside the aging process. Whether or not age is an independent risk factor, chronic periodontitis is certainly considered to be age-related (Eke et al. 2012; Haas et al. 2012; White et al. 2012; Holtfreter et al. 2010; Grossi et al. 1995).

- Gender

Studies have shown better periodontal health in women compared with men but this may be due to their increased use of health services (Christenen et al. 2003) or to better oral hygiene practices (Yu et al. 2001). The Adult Dental Health Survey supported these findings, as 68% of women reported attending for regular check-ups compared with 54% of men, and it also found that 82% of women reported brushing their teeth at least twice daily as opposed to 67% of men (Chadwick et al. 2011). A systematic review found an unexplained increase of 9% prevalence of destructive periodontal disease in men compared with women, but no difference in the rate of progression of this disease between genders (Shiau and Reynolds 2010). Therefore the role of gender remains unexplained (Genco and Borgnakke 2013; Eke et al. 2012; Haas et al. 2012; Holtfreter et al. 2012; Kocher et al. 2005; Grossi et al. 1995).

Innate factors

- Ethnicity/race

The prevalence of periodontal disease varies from country to country and within racial/ethnic groups in the same country (Albandar et al. 1999). There is an inverse relationship between the proportion of the population who report experiencing problems with their teeth and the income level of the country in which they live (Petersen 2007).

Studies conducted in the United States have shown higher levels of periodontal disease in African-Americans and other black groups compared with Caucasians (Borrell et al. 2002; Beck et al 1990). Ethnicity has also proved to be a significant factor for prevalence of periodontal disease in other countries (Kruger et al. 2010; Varenne et al. 2004).

- Genetic factors

The propensity of periodontal disease to be found in family groups has long lead to speculation that a genetic component is involved in susceptibility to the condition. Advances in techniques for exploration of genetic factors has resulted in various approaches being taken to investigate which genes may be involved in increasing susceptibility to developing periodontal disease (Genco and Borgnakke 2013; Taba et al. 2012).

Studies investigating familial or twin traits for periodontal disease have suggested that there is a genetic factor involved in aggressive periodontitis, with some showing up to 50% of siblings and offspring of those with aggressive periodontitis also affected (Rapp 2011; Meng et al. 2011; Marazita et al. 1994).

The confounding effects of environmental factors complicated the assessment of the importance of genetic factors in familial aggregation studies of chronic periodontitis (Shearer et al. 2011; Petit et al. 1994). However they did demonstrate that parents with poor periodontal health will have children with poor periodontal health. In order to compensate for environmental factors, studies of monozygotic twins have allowed the magnitude of genetic factors to be attributed. The results of these studies suggest that genetics play a smaller part in chronic periodontitis than in aggressive periodontitis (de Heens 2010; Michalowicz 1991).

In a review of studies investigating the role of gene polymorphisms in chronic periodontitis several were linked to chronic periodontitis – interleukin-1, interleukin-6, interleukin-10, vitamin D receptor and CD-14 genes – but only in specific ethnic groups, not across the general population (Laine et al. 2012).

Another approach to assessing the impact of genetic factors on chronic periodontitis has been to analyse the whole genome. To date, results have again indicated a larger role for genetics associated with aggressive rather than chronic periodontitis (Divaris et al. 2012; Schaefer et al. 2010; Kornman 2008).

It is hypothesised that increased propensity to periodontitis and other conditions such as cancer and diabetes have a shared genetic basis, but, though the evidence suggests this may be the case, definitive proof is not available and the mechanisms involved have not been explained (El-Omar et al. 2000).

At present, there is not sufficient evidence to prove a causal link between certain gene polymorphisms and severe periodontal disease (Jepsen et al. 2003). Conflicting results are found in some studies whilst others are not sufficiently robust to draw firm conclusions from (Loos et al. 2005; Weiss 2004).

- Pathogens

Chronic periodontitis requires the presence of a biofilm of dental plaque and in the past it was thought that dental plaque inevitably lead first to gingivitis, and thence to periodontitis (Armitage 2013; Marsh 2005). However, longitudinal studies have shown that the presence of dental plaque and gingivitis does not progress to periodontitis in all individuals (Loe et al. 1992; Ismail et al. 1990, Anerud et al. 1979).

Research has identified several plaque pathogens as risk factors for chronic periodontitis (Armitage 2010; Genco et al. 1996; Haffajee and Socransky 1994), and the validity of pathogens such as *Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis* and *Tanerella forsythia* as true risk factors has been demonstrated by successfully treating periodontal disease through removal of subgingival plaque (Heitz-Mayfield et al. 2002). It has also been demonstrated that the progress of the disease process for chronic periodontitis can be estimated by studying the levels of pathogens *Porphyromonas gingivalis* and *Treponema denticola* in subgingival plaque (Byrne et al. 2009).

However, all potential plaque pathogens can be found in the absence of periodontal disease, and the factors affecting the healthy balance which result in periodontal disease are insufficiently understood (Socransky and Haffajee 2005;

Lammell et al. 2000). Insufficient evidence exists to suggest that testing for the presence of specific microbes would enhance diagnosis or treatment of periodontal disease (Teles et al. 2012; da Silva-Boghossian et al. 2011; Shaddox and Walker 2009; Hayashi et al. 2006; Listgarten and Loomer 2003).

Bacteria are not the only microbes found in the plaque biofilm, and the potential role of viruses such as Epstein-Barr, herpes virus and human cytomegalovirus has provoked interest (Saygun et al. 2011; Chalabi et al. 2010; Dawson et al. 2009; Botero et al. 2007). Whilst these viruses are found in healthy sites, their numbers are much increased in sites affected by periodontal disease. It has been suggested that these viruses may weaken host defences thereby allowing proliferation of plaque pathogens leading to periodontal disease (Chalabi et al 2010; Slots 2010).

External factors

- Socio-economic status

The role of socio-economic status in periodontitis is difficult to determine due to the complexity of disentangling other associated risk factors such as poor nutrition and smoking (Klinge and Norlund 2005). Bonfim et al. (2013) divided participants in a cross-sectional trial into three groups dependent upon their periodontal health status and found that periodontal health was significantly linked with years of formal education and low income. Similar results linking indicators of poor socio-economic status with periodontal ill health have been found in other epidemiological studies (Borrell et al. 2006; Albandar and Tinoco 2002; Drury et al. 1999; Papapanou 1999).

Data collected in the 2009 Adult Dental Health Survey in the United Kingdom found that low educational attainment was highly significantly linked to smoking, suboptimal levels of toothbrushing frequency and dental attendance only when in pain (Chadwick et al. 2011). International population-based surveys in Australia (Slade et al. 2007), Denmark (Krustrup and Petersen 2006), Germany (Geyer et al. 2010), Hungary (Hermann et al. 2009), United States (Eke et al. 2012; Dye et al. 2007) and Zimbabwe (Frencken et al. 1999) have also found a significant association between periodontal disease and low levels of education. A systematic review of literature relating to the link between periodontal disease and socio-economic status in Brazil also established a strong relationship (Bastos et al. 2011).

In a systematic review exploring the link between educational attainment and chronic periodontitis, a total of 15 papers were included and the meta-analysis showed an increased odds ratio of 1.86 for chronic periodontitis among those with low educational attainment (Boillot et al. 2011).

Borrell and Crawford (2012) in their review of literature dealing with socio-economic position and periodontal disease maintain that despite multivariate analysis of data, there may still be residual effects of some variants acting as confounding factors. However, they also found that whichever measure of socio-economic position was employed – educational attainment, occupation or income – they confirm a strong link between socio-economic status and periodontal disease (Borrell and Crawford 2012).

- Medical conditions

Diabetes

Evidence exists to indicate a strong link between diabetes (Type 1 and Type 2) and periodontal disease (Lalla and Papapanou 2011; Chavarry et al. 2009; Taylor and Borgnakke 2008; Schlossman et al. 1990). Data also suggest a reciprocal relationship as poor periodontal health also leads to blood glucose levels in diabetics being less well controlled (Lalla and Papapanou 2011; Taylor and Borgnakke 2008; Genco et al. 2005; Grossi et al. 1994). Periodontal disease prevalence has also been found to increase in women with gestational diabetes (Xiong et al. 2009; Novak et al. 2006).

Longitudinal data from the First National Health and Nutrition Examination Study shows that periodontal disease is a risk factor for future development of diabetes (Demmer et al. 2008). Systematic reviews and meta-analyses have demonstrated that treatment of periodontal disease improves glycaemic control in Type 2 diabetics (Engebretson and Kocher 2013; Simpson et al. 2010; Darre et al. 2008, Janket et al. 2005).

The mechanism by which the bidirectional relationship between periodontal disease and diabetes functions is said to be related to inflammatory pathways (Seppala et al. 1993). Diabetes results in elevated levels of proinflammatory markers which in turn cause more severe periodontal disease leading to even higher levels of proinflammatory markers (Yoon et al. 2012; Dandona et al. 2004).

Collaboration between medical and dental practitioners is required to ensure diabetic patients are aware of the relationship between diabetes and periodontal disease (Karikoski et al. 2002) and are encouraged to maintain good oral hygiene thus improving both oral and general health (Lalla and Papapanou 2011).

Cardiovascular disease

A link between periodontitis and cardiovascular disease has been proposed for many years and the research base is growing. Cardiovascular outcomes have been shown to be poorer in patients with periodontitis or tooth loss in two systematic reviews (Bahekar et al. 2007; Humphrey et al. 2008). They concluded that when results were adjusted for all other known risk factors for ischaemic heart disease, periodontitis remained as a substantive risk factor.

Hujoel et al. (2003) concluded that periodontal treatment is not a causal factor for cardiovascular disease and that periodontal treatment is therefore unlikely to benefit cardiovascular outcomes. However, Ouyang et al. (2011) reviewed the topic and found stronger evidence supporting improved cardiovascular health following periodontal treatment, with the caveat that the design of the studies included was not robust enough to provide conclusive proof.

Several mechanisms have been proposed for the correlation found between cardiovascular disease and periodontal disease including infection by shared pathogens or systemic inflammatory processes leading to atherosclerosis (Cullinan and Seymour 2013). Studies have shown that inflammatory markers are elevated in patients with periodontal disease, but conflicting results are reported as to whether non-surgical periodontal treatment can reduce them (Lopez-Jornet et al. 2012; Monteiro et al. 2012).

In 2012, the American Heart Association formed an expert group to determine whether a causative association had been proven between cardiovascular disease and periodontal disease. They concluded that, to date, the robust evidence to this effect does not exist, and that the influence of common risk factors such as smoking and diabetes may explain the frequency of periodontal disease and cardiovascular disease being found as co-morbidities (Lockhart et al. 2012).

The Joint European Federation of Periodontology/American Academy of Periodontology Workshop on Periodontitis and Systemic Diseases concluded that strong evidence indicates that chronic periodontitis is a risk factor for future cardiovascular disease but further intervention studies are required (Tonetti and Van Dyke 2013).

Preterm and low birthweight babies

Despite findings that there is an association between periodontitis and preterm or low birthweight babies (Offenbacher et al. 1996), further research has failed to confirm that improved periodontal health has reduced poor pregnancy outcomes. In fact, conflicting results are reported with some studies concluding that periodontal treatment has no beneficial effect on pregnancy outcomes (Offenbacher et al. 2009; Michalowicz and Durand 2007) and others that it does (Armitage 2013). The Joint European Federation of Periodontology/American

Academy of Periodontology Workshop on Periodontitis and Systemic Diseases concluded that insufficient evidence exists to suggest that periodontal treatment will improve pregnancy outcomes for women with periodontitis (Michalowicz et al. 2013).

The exact mechanism for the putative association is unclear but it has been suggested that both periodontitis and preterm or low birthweight are linked to the release of endotoxins from Gram-negative bacterial infection. The systemic dissemination of inflammatory products common to both diseases has also been mooted. A third theory is that the foeto-maternal immune response in pregnancy affects the microbial balance in the oral plaque biofilm (Huck et al. 2011).

Obesity and metabolic syndrome

It has been found in cross-sectional studies that an association exists between obesity and periodontal disease (Han et al. 2010; Genco et al. 2005; Wood et al. 2003; Saito et al. 2001). A systematic review conducted in 2010 found a 35% increase in periodontitis in obese patients, and suggested a dose response with levels of increasing periodontal disease with increasing obesity (Chaffee and Weston 2010). Another review and meta-analysis completed by Suvan et al. (2011) found an odds ratio of 2.13 (CI 1.40, 3.26) for having periodontal disease if obese.

Susceptibility to diseases such as periodontal disease in obese individuals is thought to be modified due to the systemic inflammation obesity produces (Yoon et al. 2012; Falagas and Kompoti 2006; Genco et al. 2005).

Metabolic syndrome is diagnosed when an individual has three or more of the following disorders: increased blood pressure, raised plasma glucose, excess abdominal fat and raised high-density lipoprotein cholesterol levels. Analysis of the NHANES III data has shown that those with periodontal disease are more likely to have metabolic syndrome (D'Aiuto et al. 2008). Conversely, other studies demonstrate that metabolic syndrome is predictive of periodontal disease (Kushiyama et al. 2009; Morita et al. 2009).

Metabolic syndrome is related not only to periodontal disease, but also to diabetes and cardiovascular disease suggesting that all these conditions are interrelated (Alberti et al. 2009).

Osteoporosis

Osteoporosis is characterised by reduced bone mineral density and is found particularly in postmenopausal women where reduced levels of oestrogen leads to bone resorption (Gomes-Filho et al. 2013). Studies investigating a link between osteoporosis and periodontal disease have reported conflicting results but are suggestive of an association (Martinez-Maestre et al. 2010; Megson et al. 2010; Persson et al. 2002).

It has been hypothesised that treatments for osteoporosis may improve periodontal outcomes and some limited evidence exists to this effect e.g. Ronderos et al. (2000) using NHANES III data found that lack of dietary calcium was associated with severe periodontal disease. Calcium and Vitamin D supplements may improve tooth retention (Miley et al. 2009) and bisphosphonates reduce alveolar bone loss (Jeffcoat et al. 2007). However, bisphosphonates are associated with osteonecrosis of the jaw and so their beneficial impact on alveolar bone does not warrant their use as a treatment for periodontal disease (Hellstein et al. 2011).

Human Immunodeficiency Virus

Initial reports of very severe periodontal disease in those with human immunodeficiency virus (HIV) infection are no longer found in more recent studies in developed countries (Robinson et al. 2000; Barr et al. 1992). This may be due to the development of anti-retroviral therapy which now enhances the immune response in these subjects (Chapple and Hamburger 2000). In the developing world HIV still has a major impact on oral ill-health (Ryder et al. 2012).

<u>Psychosocial factors</u>

Psychological stress

A causal link has been strongly suggested between emotional distress and acute ulcerative necrotising gingivitis, but evidence is less conclusive with regard to chronic periodontitis (Akcali et al. 2013; da Silva et al. 1995). For instance, increased psychological stress was related to increased pocket depth (Freeman and Goss 1993), which was in turn related to increased smoking and other stress-related behaviours. Nevertheless, animal experiments have demonstrated increased periodontal ligament breakdown in stressed subjects (Breivik et al. 2006), and as stress diminishes the efficacy of immune responses this could explain a possible causal relationship (Reners and Brecx 2007). A systematic review conducted in 2007 found increased levels of stress associated with increased severity of periodontal disease (Peruzzo et al. 2007). Genco et al.

(1999) found that the detrimental effects of stress on periodontal health were alleviated in those with effective coping mechanisms. Preeja et al. (2013) suggested that increasing an individual's coping mechanisms can decrease the impact of stress on periodontal health. Borrell and Crawford (2011) used a measure of an individual's capacity to cope with change – the allostatic load – to explore the link between periodontal status and stress, and found a highly significant association in a population of Mexican Americans.

In conclusion, more research is required to fully understand the mechanism by which stress impacts negatively on periodontal health, and the possible role of stress management to improve periodontal health.

Alcohol

Analysis of data from the NHANES III study suggests not only that alcohol is a risk factor for periodontal disease, but that severity of periodontal disease is directly dose-related (Tezal et al. 2004). The authors of a systematic review conducted in 2009 concluded that the few relevant studies available point to a correlation between periodontal disease and alcohol consumption but that the widely varying methodologies precluded a meta-analysis and more studies are required (Amaral et al. 2008).

Lages et al. (2012) found a linear negative correlation with periodontal health between groups of patients who did not drink alcohol or were occasional users, patients who were moderate alcohol users, patients who were intense alcohol users and patients dependent on alcohol. In smokers, the same correlation was found but the odds of developing periodontal disease were doubled (Lages et al.

2012). Despite growing evidence of the importance of the link between high alcohol consumption and poor periodontal health, and its long-established link to oral cancer, few primary care dentists in a postal survey in Scotland were found to offer alcohol-related interventions (Shepherd et al. 2011).

Smoking

Early research investigating risk factors for periodontal disease tended to dismiss smoking, as the higher levels of plaque found in smokers was considered to be the cause of their poorer periodontal health (Genco and Borgnakke 2013). However, when data is adjusted to take account of confounding factors, including oral hygiene, cigarette smoking remains a major factor (Grossi et al. 1994). The impact on periodontal health of smoking cigars and pipes is comparable to that of cigarette smoking (Albandar et al. 2000). There is limited evidence available that exposure to second hand smoke can lead to periodontal disease (Walter et al. 2012).

It is postulated that there are several mechanisms which play a part in the effect of smoking on periodontal health. The finding that gingival bleeding is less frequent in smokers compared with non-smokers with similar plaque levels is due to the peripheral vasoconstriction caused by smoking (Morozumi et al. 2004; Mavropoulos et al. 2003; Bergstrom and Bostrom 2001). This vasoconstriction thereby masks one of the main symptoms that would prompt an individual to seek dental treatment or advice (Tonetti and Claffey 2005).

Plaque levels and oral hygiene do not explain the difference in chronic periodontitis between smokers and non-smokers. Smoking allows the proliferation of greater proportions of known periodontal pathogens such as *Porphyromonas gingivalis, Treponema denticola* and *Tanerella forsythia* thus leading to poorer periodontal health (Haffajee and Socransky 2009; Kazor et al. 1999; Zambon et al. 1996). As well as the increased proportion of periodontal pathogens in smokers, nicotine is believed to increase both the numbers and responsiveness of neutrophils and T-cells in the periodontium (Palmer et al. 2005; Loos et al. 2004; Johnson and Slach 2001; James et al. 1999; Page et al. 1983). Genetic factors also have a role in periodontal health as interleukin-1 genotype-positive individuals show increased periodontal pocketing over those without, but only in smokers (Meisel et al. 2003).

Toker et al. (2012) found in a sample of patients with chronic periodontitis that higher levels of interleukin-1 were present in the gingival crevicular fluid in smokers than non-smokers. Non-surgical periodontal treatment significantly reduced levels of interleukin-1 in both smokers and non-smokers (Toker et al. 2012).

A systematic literature review examining the relationship between smoking and tooth loss in many populations found that a causal relationship is highly probable, with all studies identified showing significantly increased tooth loss amongst smokers (Hanioka et al. 2011).

Smokers have a greater rate of alveolar bone loss and tooth loss than non-smokers, and increased frequency of smoking increases this effect (Grossi et al. 1994; Warnakulasuriya 2008; Han et al. 2012).

Bloom et al reported in 2012 that not only do smokers have poorer oral health than non-smokers; they are also more likely to postpone seeking routine treatment and to be more concerned about their oral health problems (Bloom et al. 2012). Han et al. studied a population of people with periodontitis to measure the impact of smoking and diabetes on periodontal disease. They found an odds ratio of 1.40 (CI: 1.02 – 1.90) for smokers but no additional significant relationship was found for smokers who also had diabetes (Han et al. 2012).

Torrungruang et al. (2012) found that the greatest increase in pocket depths in smokers compared with non-smokers was to be found in the posterior maxillary sextants suggesting a local effect of smoking as well as the systemic effects. Studies have shown that over half of severe periodontal cases among US adults can be attributed to smoking (Tomar and Asma 2000).

Not only have smokers been found to experience more severe disease than non-smokers, but they also have a diminished response to periodontal treatment (Adler et al. 2008; Grossi et al. 1997; Preber and Bergstrom, 1990). Reductions in pocket depth have been demonstrated to be significantly greater in non-smokers than smokers following periodontal therapy (Jin et al. 2000).

In a systematic review and meta-analysis of ten studies, Patel et al. (2012) found that bone regeneration following periodontal treatment was reduced in smokers compared with non-smokers. Researchers who conducted a systematic review of 24 papers investigating the relationship between smoking and results of periodontal surgery concluded that smoking has a negative effect on healing after periodontal surgery (Javed et al. 2012). It has also been found that smokers are significantly more likely to require more treatment after the initial treatment phase has been completed (Papantonopoulos 1999). Smokers demonstrate poorer results in response to guided tissue regeneration as compared to non-smokers (Patel et al. 2012; Tonetti 1998).

Studies examining the response of patients to periodontal treatment which included antibiotic therapy have shown that smokers respond less well than non-smokers (Tomasi and Wennstrom 2004; Kinane and Radvar 1997).

Smokers who quit have a periodontal health status intermediate between never-smokers and current smokers and after ten years they stabilise to the level of non-smokers (Chen et al. 2001). Heasman et al found that smoking cessation improved healing after periodontal treatment (Heasman et al. 2006). Cessation of smoking and non-surgical periodontal treatment lead to proliferation of pathogens associated with periodontal health and reduction in numbers of known plaque pathogens (Delima et al. 2010). Smoking cessation can reduce the rate of alveolar bone loss in chronic periodontitis patients (Chambrone et al. 2013; Bolin et al. 1993) and a reduction in pocket depths (Preshaw et al. 2005).

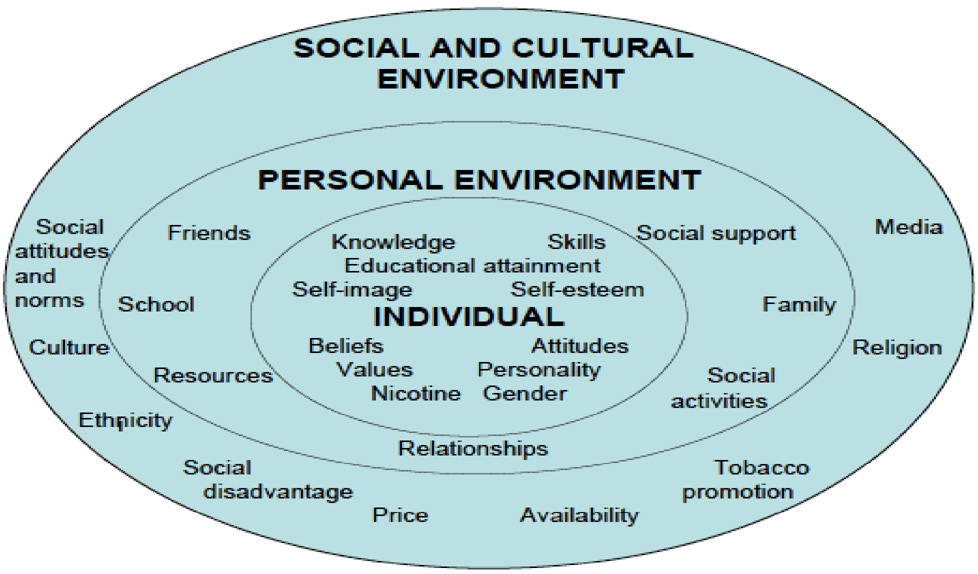
2.1.3 Detailed review of smoking

Whatever the precise mechanisms affecting the periodontal health status of smokers, sufficient evidence exists regarding the negative impact of smoking on periodontal health, and the benefits to be gained if an individual quits smoking. In light of the importance of smoking to periodontal health, further exploration of smoking: its prevalence, systemic health impact and benefits of quitting, smoking-related legislation, smoking cessation interventions and the potential role of dental personnel in changing smoking behaviours are discussed below, since in-depth knowledge of smoking together with a smoking cessation intervention should be the cornerstone of periodontal treatment.

2.1.3.1 Smoking prevalence

As the detrimental health effects of smoking have become widely known, and legislation and support have been available to support people in quitting, smoking prevalence in the United Kingdom has decreased. In 1960 61% of men and 42% of women in the UK smoked, but by the year 2000 this had reduced to 28% and 26% respectively (World Health Organisation 2011). The rate of decline has slowed however, and it seems likely that the remaining smokers are those who are completely uninterested in quitting or who find it extremely hard. Figure 2.3 shows the multitude of factors which influence decisions to take up or continue to smoke tobacco.

Figure 2.3: Factors associated with smoking (Towards A Future Without Tobacco: The report of the Smoking Prevention Working Group, Scottish Government 2006)



There is a stark contrast in the prevalence of smoking in deprived and affluent areas of Scotland, ranging from 43% of adults smoking in the most deprived areas and only 9% smoking in the most affluent areas (ASH Scotland 2010).

The Adult Dental Health Survey conducted in 2009 found that 22% of over sixteen year olds in England, Northern Ireland and Wales were current smokers, and that smokers were more likely to be edentulous than non-smokers – 24% versus 22% (Chadwick et al, 2011). Younger age groups were more likely to smoke, as were men (24%) rather than women (21%). Thirty percent of adults in households with manual occupations smoked as opposed to 16% from managerial and professional occupation households (Chadwick et al, 2011).

The Scottish Executive and Government have had various targets for smoking rates and in 2005 a reduction in adult smoking to 22% by 2010 was set (ASH Scotland 2010). Latest figures available show that adult smoking prevalence across Scotland is 23.3%, with 25% of men and 22% of women smoking. Those in the 25 – 34 year age group have the highest smoking prevalence at 31% and 26% of men and women respectively, reducing to 19% of men and 17% of women in the 60 – 74 years age group. Extreme differences in smoking prevalence are found by socioeconomic status in Scotland with 40% of those in the most deprived areas smoking as compared with 11% in the least deprived areas. The adult smoking prevalence in Argyll & Bute Community Health Partnership area is 22% (Scottish Household Survey 2011).

One of NHS Health Scotland's key targets known as the HEAT (Health Efficiency Access and Treatment) targets stated that, through smoking cessation services, 8% of smokers should be supported to successfully quit over the period 2008-2011 (NHS Health Scotland 2007) and Argyll & Bute CHP met this target (Galbraith and Hecht, 2012). An updated HEAT target aims that NHS Scotland delivers at least 80,000 successful quit attempts at one month post quit, including 48,000 in the most deprived SIMD areas in each Board over the three years ending March 2014. NHS Highland is exceeding the target for the population as a whole and is marginally ahead of target in the most deprived areas (ASH Scotland Tobacco Factsheet 2013).

2.1.3.2 Oral health impacts of smoking other than chronic periodontitis

In addition to its impact on the periodontal tissues, smoking is associated with discolouration of the teeth and tooth-coloured restorations, halitosis, soft tissue lesions, pre-cancerous lesions and oral cancer (Beaglehole and Watt 2004).

Benign smoking-related soft tissue lesions include smoking related melanosis which is characterised by brown pigmented spots on the oral mucosa which can be localised or widespread. Black or brown hairy tongue is a benign lesion on the dorsum of the tongue caused by staining of the filiform papillae by nicotine, coffee or red wine (Bagan et al. 2010). Median rhomboid glossitis presents as a characteristic red lesion in the midline of the dorsal surface of the tongue anterior to the circumvallate papillae which is created by atrophy of the papillae (Warnakulasuriya et al. 2010). Nicotinic stomatitis is mainly associated with smoking pipes or cigars and presents as keratosis of the palate (Hunter and Yeoman 2013; Bagan et al. 2010; Warnakulasuriya et al. 2010).

Leukoplakia, erythroplakia and chronic hyperplastic candidosis are among the smoking-related pre-cancerous lesions found in the oral cavity (Brocklehust et al. 2010). Leukoplakia is characterised by white or speckled lesions which cannot be explained by another cause (Hunter and Yeoman 2013). It is potentially malignant and a biopsy will show the degree of dysplasia present. In a ten year period 5 – 20% of leukoplakias become malignant. Erythroplakia presents as a red patch on the oral mucosa and requires a biopsy to determine its malignant potential. Erythroplakias are more likely to become malignant than leukoplakias. Chronic hyperplastic candidosis is a potentially malignant candidal infection which is likely to recur if the patient continues to smoke. It is characterised by white plaques of varying thickness and shows dysplasia in 15 – 50% of lesions (Bagan et al. 2010).

The incidence of oral cancer is increasing in Scotland and is greater than in the rest of the UK (Conway et al. 2010). It is found twice as frequently in males rather than females, and is commonest in older age groups. However, the number of younger people being diagnosed with oral cancer is increasing (Mackenzie et al. 2000). Whatever the age group or gender of those with oral cancer, cigarette smoking and alcohol intake are strong risk factors. Oral cancer and its risk factors are strongly linked to socio-economic status and Conway et al. found widening social inequalities amongst those diagnosed with oral cancer in Scotland between 1976 and 2002 (Conway et al. 2007).

Despite the relative ease of examination of the oral mucosa, half of those with oral cancer already have metastases on diagnosis, which greatly reduces survival rates (McCann et al. 2000). Public health campaigns advising the population of Scotland of the importance of oral examinations and educational initiatives with dental professionals demonstrating the role they have in the prevention and early diagnosis of oral cancer, have failed to improve the five-year survival rate of 50% (Brocklehurst et al. 2010; Carter and Ogden 2007; McCann et al. 2000).

Oral cancer should be included in the differential diagnosis of any patient presenting with one or more of the following which cannot be explained by another cause (Hunter and Yeoman 2013; Bagan et al. 2010):

- Non-healing ulcer present for several weeks
- Red or white or speckled lesion
- Bony or soft tissue swelling
- Mobile teeth not related to periodontal disease
- Altered sensation e.g. paraesthesia
- Altered function e.g. difficulty in moving tongue
- Mass in neck or lymphadenopathy

2.1.3.3 Systemic health effects of smoking

The adverse health effects of cigarette smoking have been recognised for decades since the work of Richard Doll proved a link between cigarette smoking and lung cancer in 1950 (Doll and Hill 1950) and with increased mortality from all causes in a population of doctors in 1954 (Doll and Hill 1954). Since then, tobacco has been shown to be a causal factor in many other diseases, notably chronic obstructive pulmonary disease, peripheral vascular disease and coronary heart disease (Doll et al. 2004; Peto et al. 1996).

The estimated annual number of smoking-related deaths in Scotland is 13,000 (ASH Scotland 2010) and 1,500 – 2,000 of these are thought to be due to second hand smoke (NHS Health Scotland 2005). Adults exposed to second hand smoke have a 20-30% increased risk of lung cancer and coronary heart disease. Rates of asthma, bronchitis, pneumonia and croup are all increased in children exposed to second hand smoke, as is sudden infant death syndrome (British Medical Association 2004).

The National Institute for Health and Clinical Excellence (NICE) guidance produced in 2006 stated that not only is smoking the greatest cause of preventable morbidity, but that it is also the major factor in explaining health inequalities between high and low socioeconomic groups (NICE 2006).

Action on Smoking and Health (Scotland) - ASH Scotland - is a campaigning organisation seeking effective tobacco control legislation in Scotland. They have a role in raising awareness about the harm caused by tobacco, protecting children from tobacco and influencing legislation about tobacco. They also contribute to public health policies targeted at smokers wishing to quit. They produced statistics estimating the cost of smoking to the NHS in Scotland to have been £323 million in 2009, taking into account treating tobacco-related disease, outpatient and inpatient costs and prescription costs (ASH Scotland 2013). They also estimate that in the period from 2006 – 2010, £1.1 billion was spent annually in Scotland for all smoking-related costs including health and productivity losses (ASH Scotland 2013).

In addition to the direct effects of cigarette smoking studies have shown that adolescents who smoke cigarettes are more likely to use smokeless tobacco, alcohol and illegal drugs (Torabi et al. 1993). Tobacco is therefore described as a “gateway drug” which encourages uptake of other health-damaging behaviours. The differential between rates of alcohol and illegal drug use in smokers and non-smokers is greater in children with behavioural difficulties such as those with attention deficit hyperactivity disorder (Biederman et al. 2006).

Table 2.2: Health benefits of quitting smoking (American Cancer Society 2010)

Time after quitting	**Health benefit**
20 minutes	Heart rate and blood pressure drops
12 hours	Carbon monoxide level in bloodstream drops to normal
2weeks – 3 months	Circulation improves and lung function increases
1 – 9 months	Coughing and shortness of breath decreases
1 year	Increased risk of coronary heart disease halves
5 years	Stroke risk reduces to that of a non-smoker
10 years	Lung cancer death rate half of a continuing smoker

2.1.3.4 Chronic periodontitis, smoking and dental implants

The use of osseointegrated dental implants to replace natural teeth is increasing and it would be expected that chronic periodontitis could affect their long-term success (Singh 2011). Pye et al. (2009) found in a review of studies examining peri-implant infections that similar pathogens were found as in chronic periodontitis e.g. *Porphyromonas gingivalis* and *Treponema denticola.* In a five year prospective trial, Weenstrom et al. (2004) found that in patients susceptible to periodontitis only small levels of bone loss occurred over the follow-up period. Anner et al. (2010) found in a retrospective assessment of patients over a ten-year period that those with chronic periodontitis had increased risk of losing their dental implants – 14% rather than 8% in those without periodontitis – but this did not reach statistical significance.

Aloufi et al. (2009) found that there was significantly greater bone loss around implants in patients with severe periodontitis. In a prospective study among patients susceptible to periodontitis Machtei et al. (2007) found that bone loss was more marked in molar regions than at the front of the mouth. Levin et al. (2011) conducted a cohort study to evaluate the impact of periodontal status on implant survival and found that poor periodontal status did adversely affect survival rates. They also found a fluctuating risk of implant loss over a long-term follow-up period suggesting that the pattern of peri-implantitis is similar to that of chronic periodontitis around natural teeth with bursts of activity causing significant destruction of surrounding tissues (Levin et al. 2011).

Smoking has been found to be a risk factor for early loss of dental implants in many studies, with a failure rate of around double that of non-smokers being found consistently (Anner et al. 2010; Baig and Rajan 2007; Mundt et al. 2006; Galindo-Moreno et al. 2005; Nitzan et al. 2005; Levin et al. 2004). As well as being associated with increased bone loss, bone grafts are less successful in smokers and peri-implantitis is more common (Heitz-Mayfield 2008; Galindo-Moreno et al. 2005; Nitzan et al. 2005; Baelum and Ellegard 2004; Lindquist et al. 1997; Haas et al. 1996). It is understood that the mechanisms by which smoking affects periodontal health by its impact on wound healing and immune responses, also affects peri-implant tissues although the extent and rate of progression may be greater (Lang et al. 2011).

The increased failure rate of dental implants in smokers appears to be dose-related, with heavy smokers being more greatly affected than light or moderate smokers (Bain 2003; Lindquist et al. 1996; Bain and Moy 1993). Dental implant failure rates are higher in the maxilla than in the mandible, which may be due to the lower bone density of the maxilla (Nitzan et al. 2005; Lambert et al. 2000; Haas et al. 1996; Bain and Moy 1993).

A higher level of marginal bone loss around implants was found in smokers than non-smokers by Nitzan et al. in 2005, and Anner et al. 2010 found reduced osseointegration. Stoker et al. discovered, in a randomised controlled trial comparing three different implant-retained prostheses, that marginal bone loss was twice that in smokers as in non-smokers whichever type of prosthesis they received (Stoker et al. 2012). However, the overall rate of implant loss remains relatively low in smokers and so smoking should not be seen as a prohibiting factor when considering implant placement (Johnson and Hill 2004). Smokers should of course be informed of the increased risk of implant loss and encouraged to quit (Peleg et al. 2006).

2.1.4 Addiction

It is widely reported that around seventy percent of smokers would like to quit (Health Scotland and ASH Scotland 2010; NICE 2006; Beaglehole and Watt 2004) However, tobacco is a highly addictive drug and whilst a third of smokers make a quit attempt each year, only two percent succeed.

Nicotine is the constituent of tobacco which leads to its addictive nature. Inhaled tobacco smoke enters the bloodstream and reaches the brain within seconds

(Hatsukami et al. 2008). The nicotinic receptors in the brain are then activated, which allows the release of several neurotransmitters such as dopamine, serotonin and acetylcholine which produce feelings of wellbeing (Glover et al. 2003). Peak dopamine levels are reached five minutes after smoking a cigarette, and the effects of the nicotine reduce significantly after thirty minutes (Royal College of Physicians 2007). Smoking another cigarette will reactivate the dopamine reward system and reproduce feelings of wellbeing.

Chronic use of addictive substances such as nicotine is thought to modify the dopamine reward system so that increased doses are required to produce the same effects. This neuroadaptation also explains withdrawal symptoms if the substance is withdrawn, and makes relapse more likely (Benowitz 2008). Withdrawal symptoms are also a response to motivational symptoms experienced when an addictive substance is withdrawn e.g. dysphoria, depression, irritability and anxiety, although do not appear to be related to underlying depressive illness (Edwards and Kendler 2011).

Studies in twins raised in separate environments have shown a genetic component in vulnerability to addiction to all substances including tobacco (Vink et al. 2005). It has not been possible as yet to determine the exact genes associated with nicotine addiction but it would seem that there are many genes involved (The Tobacco and Genetics Consortium 2010).

The neurological effects of nicotine explain part of the addictive nature of smoking cigarettes; however, there is more than physiology at play. Behavioural theories of addiction include the drug self-administration model in which a combination of neurological effects and social effects such as admiration of one's peers encourages continued drug use (Altman et al. 1996; Benowitz 2008). Another theory postulates that cues are important in sustaining drug misuse e.g. smelling alcohol or finishing a meal when one would normally light up a cigarette. This cue exposure theory explains why cravings may persist long after physical dependence has been overcome (Drummond et al. 2001).

Cognitive theories of addiction suggest that addiction is a failure of self-regulation, with a defective reliance on substance misuse to maintain psychological equilibrium, and has been demonstrated in smokers (Waters et al. 2003). It has been suggested that some personality types have a higher risk of developing addiction than others and some evidence exists that those personalities scoring high for irritability and impulsivity are more vulnerable (Conway et al. 2003).

There are several rational choice theory models of addiction which propose that short term benefits are heavily weighted over longer-term ones, so that the immediate gratification obtained by having a cigarette now may rationally outweigh the long-term benefits of stopping (Vuchinich and Heather 2003).

Sociocultural factors such as socioeconomic background, exposure to drug-taking and peer pressure also influence the likelihood of legal and illegal substance misuse (Pruitt et al. 1991). Increased social capital has been shown to improve smoking quit rates in a British population (Giordano and Lindstrom 2011).

In addition to the myriad theories of addiction, many models of behavioural change have been described which aim to encourage people to avoid unhealthy behaviours in favour of more beneficial ones. When developing behaviour change interventions, such as smoking cessation interventions, a theoretically-based model can be used to help individuals to adopt a healthy change and also to sustain it (Family Health International 2007). A review of commonly cited behaviour change models can be found in Appendix 1.

2.1.5 Smoking cessation interventions

Research into the most effective methods of delivering smoking cessation advice is ongoing, but there is robust evidence existing to show that they are worthwhile. A Cochrane Review conducted in 2000 showed that all available interventions are more effective than doing nothing (Lancaster et al. 2000).

Two types of smoking cessation intervention are recommended for use by the Scottish Government i.e. brief interventions and intensive interventions, and these are commonly used worldwide (Health Scotland and ASH Scotland 2010; Gordon 2010; Gonseth et al. 2010; Hanioka et al. 2010; Twardella 2007; Wang 1994).

Brief Intervention

Brief interventions consist of **asking** the patient about their smoking habits, **advising** them of the benefits of quitting and **assessing** their readiness to quit (Gordon 2010; Twardella 2007). This is also known as the 3 As model of smoking cessation. No more than 10 minutes should be spent on this activity. If the patient is interested in quitting at this point they should be referred to specialist services (Health Scotland and ASH Scotland 2010).

Intensive intervention

Intensive smoking cessation interventions are most often delivered by specialist smoking cessation services although other healthcare professionals who are suitably trained may also provide them. As well as following the steps of a brief intervention, the healthcare provider goes on to **assist** the smoker in quitting, and **arranges** follow-up appointments. This is referred to as the 5 As model of smoking cessation (Health Scotland and ASH Scotland 2010).

Evidence points to smoking cessation interventions which combine pharmacological and behavioural support being most effective, with a Cochrane systematic review and meta-analysis finding a risk ratio of 1.82 in favour of combined therapy over control groups (Stead and Lancaster 2012; NICE 2006).

2.1.5.1 Behavioural support

NHS Health Scotland in conjunction with ASH Scotland have devised guidelines for smoking cessation interventions, the behavioural support component of which is based on the theories of addiction (see page 58) and behaviour change (see page 60 and Appendix 2). The details of the smoking cessation intervention described here are based on the model devised by NHS Health Scotland.

The behavioural support component of the smoking cessation intervention consists of preparing the smoker for their quit attempt (see Stages of Change model, Appendix 1) by encouraging them to set a quit date, and to avoid changing their smoking habits prior to this. Ideally the last cigarette should be smoked just before the quit date visit to the stop smoking services. Smokers should be advised to tell friends and family of the date they are going to quit in order to maximise the support they receive (Park et al. 2012; Patten 2012). They should remove all smoking paraphernalia prior to the quit session to avoid temptation. The counsellor encourages the client to explore their smoking habits and the difficulties they face in quitting. If they have made previous quit attempts, the reasons for relapse should be explored (NHS Health Scotland and ASH Scotland 2010). As there is a relationship between the level of dependence on nicotine and the difficulty in giving up smoking, the national smoking cessation intervention recommends assessing the level of nicotine dependence prior to the quit attempt getting underway. There are several tools available for determining nicotine dependence but the Fagerstrom test of nicotine dependence is the most frequently used tool in Scotland and this test has been validated in assessing dependence and predicting relapse (Zhou et al. 2009, Piper et al. 2006) (see Table 2.4. page 82).

The majority of smokers will have lapses during their quit attempts i.e. will smoke a few puffs or a few cigarettes at a weak moment but many will then continue without tobacco longer term. It is estimated from studies that 60-90% of individuals who stop smoking will relapse i.e. sustained use of smoking, within the first year (Krall et al. 2002). A systematic literature review of relapse prevention strategies did not identify any one strategy which was more successful than the others and concluded that more research is required to identify the best methods to prevent relapse (Hajek et al. 2009). Nevertheless, it is important that counsellors help clients to recognise the dangers of relapse and identify their own strategies for dealing with triggers to smoke (McEwen et al. 2006).

Information regarding the likely consequences of stopping smoking can help clients to prepare therefore counsellors should advise clients that they will experience nicotine withdrawal symptoms which can be counteracted by using nicotine replacement therapy (NRT). Cravings can continue for several years in some people but NRT, and distraction strategies such as physical exercise can help. This approach shows the combined thrust of behavioural and pharmacological support in intensive smoking cessation interventions.

A common concern among potential quitters is that they will gain weight. Nicotine is an appetite suppressant and so stopping smoking can increase food intake due to increased appetite. Many people use food as a cigarette substitute in the early stages of a quit attempt. It is normal for a smoker to gain six kilograms in the twelve months after quitting but it is not inevitable. Increasing exercise, keeping healthy snacks at hand and using chewing gum can help minimise weight gain. A Cochrane review of intervention aimed at reducing weight gain post quitting smoking found little evidence of long term success for any pharmacological or behavioural intervention, but exercise proved most successful (Farley et al. 2011). These additional concerns are debated and discussed with smoking cessation counsellors as they assist clients to quit.

There are many potential effects of stopping smoking, some of them negative in the short-term e.g. disturbed sleep, irritability, bleeding gums; therefore counsellors must ensure clients are well-informed of the overwhelmingly positive short and long-term health, social and financial benefits of quitting smoking (Hajek et al. 2009).

Clients are therefore supported to develop their own strategies for coping with cravings, and to review their motivations for quitting (Lai et al. 2010; Miller 2002). Reassurance and advice should be offered at the quit visit and each follow-up visit, regardless of whether the quit attempt is succeeding (Soria et al. 2006; Stein et al. 2006). Evidence shows that a minimum of 4 hour-long weekly sessions are required to maximise the benefit of behavioural support, with 6-8 sessions being recommended as ideal (NHS Health Scotland and ASH Scotland 2010).

2.1.5.2 Pharmacological support

Nicotine is a highly addictive substance which makes quitting smoking very difficult for most people. As addiction to smoking is due to nicotine, the use of nicotine replacement therapy (NRT) alleviates withdrawal symptoms. No adverse effects have been found from the use of NRT, because despite its highly addictive nature, it is one of the less harmful of the over 4000 chemicals found in tobacco smoke, and the amount of nicotine delivered by any NRT product is less than that obtained by smoking (US Department of Health and Human Services 2004). A Cochrane Review conducted in 2008 showed no significant difference in the quit rates achieved using any of the NRT products available and so the personal choice of the person wishing to quit will determine which to provide (Stead et al. 2008). This review demonstrated a 50-70% increase in quit rates using a single NRT product over control groups.

Further research shows that a combination of nicotine replacement therapies can safely be used, and are more effective than only one therapy e.g. patch and nicotine chewing gum (Silagy et al. 2004). This combination provides a steady background level of nicotine from the patch, as well as a means of providing an instant nicotine boost to overcome cravings. An additional 35% of smokers succeed in quitting using a combination of NRT products compared with those using only one (Stead et al. 2008).

Two drugs which do not contain nicotine are used in smoking cessation. Bupropion is an atypical antidepressant and has been shown to be at least as effective as NRT in assisting people in stopping smoking. It has not been associated with adverse side-effects. The mechanism by which bupropion assists in smoking cessation is unclear, but it is thought to involve the dopamine reward system (NICE 2007).

Varenicline has been developed specifically to assist people to quit smoking and has been demonstrated to increase quit rates by around 50% more than single NRT products or bupropion, and 10-20% more than combination NRT. It acts on the nicotinic receptors of the brain in a similar manner to nicotine. However, it has been implicated in causing serious, potentially psychotic, side-effects in about twenty percent of recipients but is worth considering for short-term use. Either of these drugs can be used in place of, but not in addition to NRT (NICE 2007).

Studies have shown that providing NRT increases six month cessation rates from 2-3% to 5-8% (Stead et al. 2012; West et al. 2000). Intensive counselling support alone gives around 7% 6-month quit rates but this increases to 13 – 19% if intensive support is provided by specialist services and supplemented by NRT or bupropion (Silagy et al. 2004).

Due to the evidence of the increased effectiveness of smoking cessation interventions when the person wishing to quit is fully engaged, NRT should only be prescribed when they have set a quit date and agreed to counselling support (NHS Health Scotland and ASH Scotland 2010).

Guidance has been produced by NICE (2006), and by both UK and Scottish Governments, indicating that a brief smoking cessation intervention should be provided opportunistically to all smokers by all healthcare providers, including dental professionals, at appropriate times. Intensive support should then be arranged in-house if the expertise is available, or be referring the client on to NHS specialist stop smoking services.

2.1.6 Smoking Cessation in the Dental Setting

The Smoking Cessation Guidelines for Scotland (2004) and NICE Guidelines (2006) indicate that all healthcare professionals, including dental professionals, should determine their patients' smoking habits, advise them to quit and provide smoking cessation advice or refer any patient indicating a desire to quit to specialist services. It is particularly pertinent for dental personnel to provide this support in light of the oral health impacts of smoking.

Research into the effects of cigarette smoking on oral health began in the 1980s and the link between cigarette smoking and oral disease is proven, particularly the association with oral cancer and periodontal disease (Mecklenberg 1998), but also wound healing, success of dental implants and aesthetic considerations (Watt et al. 2003). An improvement in periodontal health over and above that seen in smokers receiving periodontal treatment alone has been demonstrated in those quitting smoking (Preshaw et al. 2005). A study examining tooth loss among young adults in Japan indicated that smokers experience more loss of teeth than non-smokers (Ojima et al. 2007).

Despite the importance to public health of smoking cessation and the variety of studies indicating that the dental team has a role to play in helping their patients to quit, a Cochrane Review in 2006 did not find studies of sufficient rigour to prove this (Carr and Ebbert 2006). An update of this review provided further, but still limited, evidence pointing to the effectiveness of smoking cessation interventions undertaken in a dental setting (Carr and Ebbert 2012; Needleman et al. 2010).

Several more recent studies have shown that smoking cessation interventions can be successfully delivered by dental hygienists (Gordon et al. 2009; Binnie et al. 2007). As dental hygienists are the dental team members most often providing behaviour change advice, it is reasonable to think that they are ideally suited to provide smoking cessation support. Both brief and intensive smoking cessation interventions provided by the dental team have been shown to be effective in recent studies across primary and secondary care, and in public and private dental facilities (Gordon et al. 2010; Gonseth et al. 2010; Hanioka et al. 2010).

Evidence pointing to the effectiveness of smoking cessation services provided by dental professionals is growing, yet few dental teams assist patients in giving up smoking (Gonseth et al. 2010; Binnie 2009; Brothwell and Armstrong 2004). The main barriers cited include lack of training, lack of time, uncertainty of their effectiveness and fear that patients will not accept dental professionals tackling this issue. Even recent studies examining the attitudes of dentists and dental students to smoking cessation show that these barriers still exist (Clareboets et al. 2010; Rosseel et al. 2009), although most dentists do ask their patients about their smoking habits and advise them on the oral health effects of smoking (Johnson et al. 2006). However, evidence shows that the status of a dental practice can be enhanced if it is seen to be promoting general, as well as oral, health (Watt et al. 2000). Several studies have shown that patients expect their dental team to discuss smoking habits with them (Rosseel et al. 2009, Terrades et al. 2009). Campbell et al. (1999) showed that in a US population over half thought that smoking cessation support should be provided in the dental setting.

The British Dental Association (BDA) guide to helping smokers stop (Beaglehole and Watt 2004) advocates the use of a 4 As approach. This involves **asking** all patients about their smoking status, **advising** them on the value of quitting, **assessing** their readiness to quit and **arranging** a referral to local smoking cessation services for motivated smokers. This mirrors the 3As approach described on page 61 but integrates the referral of smokers to specialist stop smoking services into the model, hence the additional “A”. The BDA also advocate that, where appropriately trained dental professionals are available, they may proceed to **assist** smokers to quit in the dental setting i.e. to adopt the 5As model described on page 61. The assistance given to those who receive smoking cessation support in the dental surgery includes provision of nicotine replacement therapy (NRT), behavioural advice and encouragement. Evidence suggests that using this more intensive 5 As approach in the dental surgery is more effective than referral (Gordon et al. 2007; Nohlert et al. 2009).

It is thought that dentists may become discouraged due to the small proportion of patients with whom they broach the subject of quitting actually stop smoking, but the cumulative effect if all dentists were to do so would produce a very large public health benefit (Chestnutt 2010).

2.1.7 Conclusions

This literature review has shown that chronic periodontitis has a multifactorial aetiology and that some of the risk factors involved e.g. gender, genetics and medical conditions are innate and therefore not conducive to modification. However, a knowledge of these innate factors may allow better targeting of resources at those most likely to benefit from periodontal therapy.

Evidence showing an association between medical conditions such as diabetes and cardiovascular disease with periodontal disease has not yet proven a causative link, but in spite of this, patients should be informed of the evidence that exists. This may allow them to make more informed decisions regarding the periodontal care they seek from dental professionals and the oral hygiene measures they undertake at home to maximise their periodontal health. It has been shown that the aforementioned medical conditions and periodontal disease share common risk factors. It therefore makes sense to approach public health and preventive strategies in an integrated manner with other healthcare professionals in order to improve both oral and general health (Sheiham and Watt 2000).

Chronic periodontitis has been found in this literature review to impact negatively on oral health-related quality of life, as has tobacco use. Prevention and treatment of periodontal disease, and smoking cessation support from dental professionals should therefore result in improved quality of life for dental patients.

This literature review provides evidence that smoking is a major risk factor for chronic periodontitis, and therefore all periodontal treatment regimes should include some form of smoking cessation intervention. Scottish and UK Government legislation (NHS Health Scotland & ASH Scotland 2010; Department of Health 2011; NICE 2006), as well as guidance produced by dental professional bodies, also indicate that dental professionals, in common with all other healthcare professionals, should make the most of all opportunities to provide smoking cessation interventions.

2.2 Purpose of Study

2.2.0 Introduction

The narrative literature review has demonstrated the high prevalence of chronic periodontitis found globally (Baelum and Lopez 2013; Kinane and Attstrom 2005) and a diversity of genetic, environmental and behavioural factors which determine periodontal health (Petersen and Ogawa 2005). Evidence of poor periodontal health causing a negative impact on oral health-related quality of life was also found in the narrative literature review (Bernabe and Marcenes 2010;

Nuttall et al. 2011). Furthermore, the narrative review indicated that all healthcare professionals, including dental professionals have a responsibility to offer tobacco cessation support at every opportunity (Clareboets et al. 2010; Rosseel et al. 2009).

The narrative literature review encountered limited previous research in the field of smoking cessation in dental care settings, especially in primary care, although the available evidence suggests that it can be successful in supporting smokers to quit (Carr and Ebbert 2012). Evidence of the effectiveness of provision of smoking cessation interventions in remote and rural primary dental care was lacking. The results of the narrative literature review led to the formulation of the research question found in section 2.2.1.

2.2.1 Research question

Is there an additional benefit for the promotion of periodontal health in a remote and rural population, achieved by comparing (A) an intensive smoking cessation intervention provided by a dental therapist in the dental surgery, with (B) an intensive smoking cessation intervention provided by an NHS smoking cessation specialist outwith a dental setting?

2.2.2 Aim and objectives

Aim

To determine the amount of additional benefit for the promotion of periodontal health in a remote and rural population, achieved by comparing (A) an intensive smoking cessation intervention provided by a dental therapist in the dental surgery, with (B) an intensive smoking cessation intervention provided by an NHS smoking cessation specialist outwith a dental setting.

<u>Research objectives</u>

1. To determine the number of regular dental attenders who are smokers who wish to quit smoking.
2. To apply protocol (A) or protocol (B) to randomly allocated groups of smokers who wish to quit.
3. To assess the effectiveness of protocols (A) and (B) as defined by self-report and biochemical markers.
4. To compare the benefit of protocols (A) and (B) on the periodontal health of successful quitters.
5. To determine the improvement in the impact of oral health on daily living when periodontal health improves.

2.3 Method

2.3.0 Introduction

In any study investigating the effectiveness of an intervention the gold standard design is a randomised controlled trial. As subjects are randomly assigned to the control and intervention groups, provided that the numbers are sufficient, known and unknown confounding factors should be randomly distributed thus ensuring that any effect found can be attributed the intervention (Higgins et al. 2011).

As this study aims to compare the effectiveness of two different smoking cessation interventions a blinded randomised controlled trial design is utilised to maximise the validity of the results (Schultz et al. 2010).

2.3.1 Study population

The population included in this study were adults who regularly attended a rural salaried general dental practice for dental care. Adults were defined as those eighteen years and over and no upper age limit was applied. Regular attenders were defined as registered patients who had attended the dental practice at least once per year in the previous two years. All those invited to participate were cigarette smokers wishing to quit and who were not currently attending smoking cessation services. Those who smoked on a daily basis were deemed to be smokers irrespective of the quantity of cigarettes consumed.

2.3.2 Exclusion criteria

In all research it is imperative to obtain informed consent from participants and therefore any adult meeting other inclusion criteria but who did not have the capacity to provide informed consent was excluded from the study (Adults with Incapacity (Scotland) Act 2000 s5).

Pregnant smokers were excluded from this study as very successful and well-established specialised stop smoking support provided by midwives was available locally. Provision of tobacco cessation counselling and support for this specific group has proven to be most effective when provided alongside ante-natal care (NHS Health Scotland and ASH Scotland 2010).

Any potential participant with a medical condition known to adversely affect periodontal health was excluded as the response of their periodontal tissues to quitting smoking could be masked by their condition. The medical conditions which led to exclusion from the study included diabetes and fulminating immune deficiency diseases (Lalla and Papapanou 2011). Similarly, anyone receiving medication known to affect gingival health e.g. cyclosporin, an immune suppressant used in transplant recipients, was excluded from the study (Hyland et al. 2003). Those receiving palliative care for terminal illness were also excluded.

Individuals who were receiving stop smoking support elsewhere were excluded from the study as this would confound results making it impossible to attribute any changes to the interventions applied as part of this study.

2.3.3 Recruitment strategy

All participants recruited to this study were registered dental patients who attended regularly for dental care, and their smoking status was known to the dental team. Leaflets giving information about the research project were displayed at the dental reception desk and attention drawn to them by the dental receptionists. All patients confirmed as smokers by their dentist or dental hygienist/therapist were verbally informed of the project and offered an information leaflet. The contact details of the researcher were listed on the leaflet – both a landline and dedicated mobile telephone number were available.

The local general medical practitioners were informed of the project and were fully in support, as were the heads of department of all other healthcare and social services available in the local community hospital. The Planning and Public Involvement Officer of Argyll and Bute CHP ensured that patient groups were aware of the project.

In order to take full advantage of national advertising of smoking cessation activities for No Smoking Day, information stands were deployed in local healthcare settings, colleges, youth clubs, supermarkets etc. and staffed by the researcher in conjunction with specialist stop smoking counsellors. Recruitment of smokers was conducted from June 2011 – December 2012.

2.3.4 Sample and sampling methods

<u>Sample size</u>

A sample size of 65 in the control group and 65 in the intervention group was required to give an 80% power to detect a difference in means of 8% in periodontal pocket depth between the control group (40%) and the intervention group (42%) with a 5% two-sided significance level. Power analysis was based upon previously reported data (Adler et al. 2008).

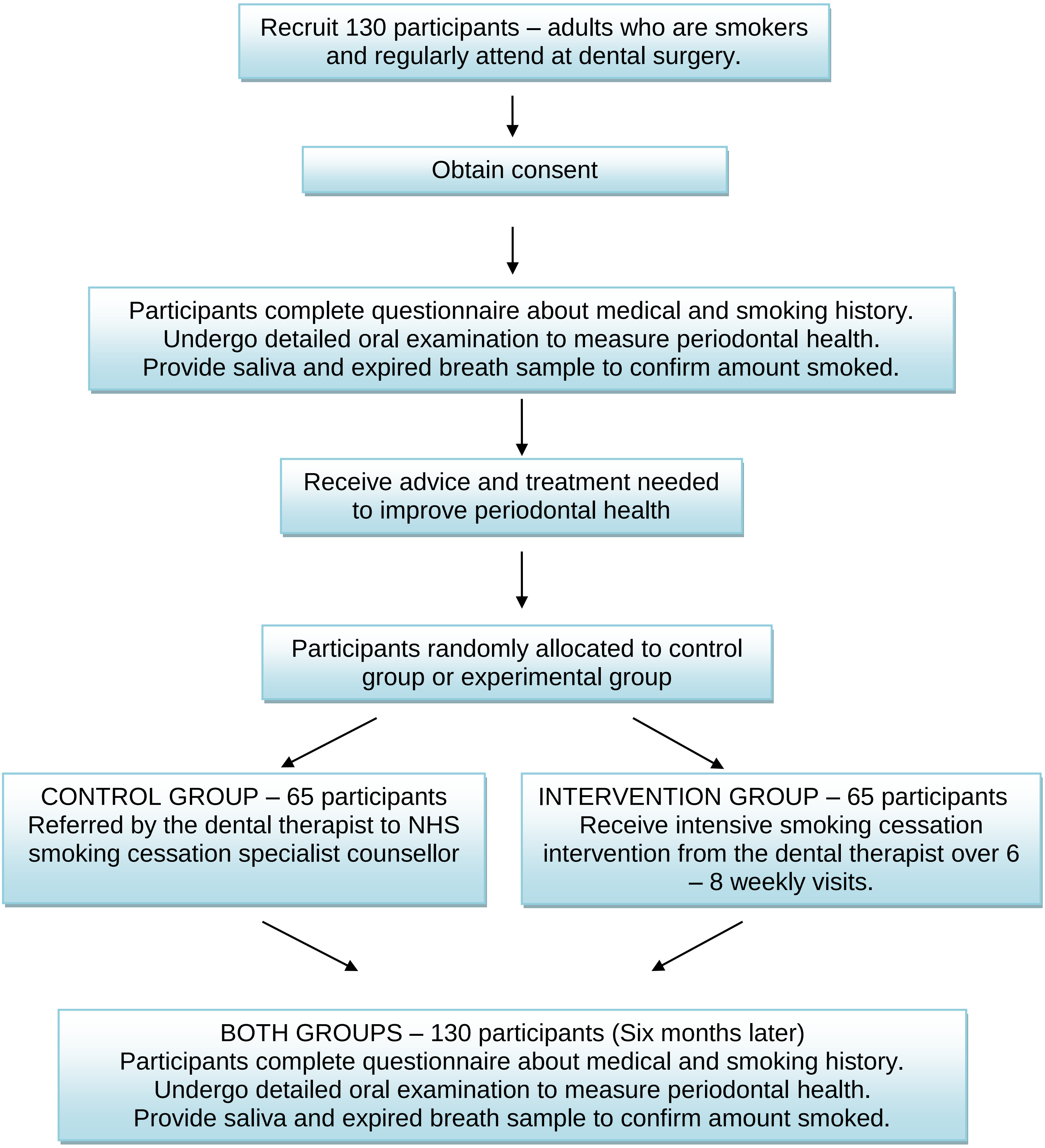
Randomisation

An electronic randomisation package (www.random.org) was used to produce two lists containing all numbers between 1 and 200. Each number was randomly assigned to List 1 – control group – or List 2 – intervention group. The participant was then assigned to one of these two groups according to their individual participant identifier. The production of the randomisation lists and assignment of each participant was undertaken by an independent administrator, an employee of the Dental Directorate of Argyll & Bute CHP based distant form the research site and with no other involvement in the study.

KE, who undertook the initial and follow-up clinical examinations, was unaware of whether the participants had been assigned to the control or intervention groups until after participants had completed the trial.

The trial diagram illustrating the research process is shown in Figure 2.4.

Figure 2.4: Summary of Research Process for Randomised Controlled Trial



2.3.5 Control and Experimental Interventions

The smoking cessation interventions administered in this randomised controlled trial were those recommended by the Scottish Government document “A Guide to Smoking Cessation in Scotland” (NHS Health Scotland and ASH Scotland 2010). The dental therapist, a long-standing employee of Argyll & Bute CHP Salaried Primary Care Dental Services who had demonstrated an interest in helping patients quit smoking, provided the intensive smoking cessation intervention in the dental surgery – Protocol (A). She attended the nationally-recognised training in stop smoking support at Glasgow Caledonian University. She obtained a Certificate of Accreditation in Specialist Stop Smoking Support for Individuals and Groups. The dental therapist therefore provided periodontal advice and stop smoking support to participants in the experimental group.

2.3.5.1 The dental health and smoking habits questionnaire

The questionnaire inquired about the participant’s smoking status, periodontal health and oral health-related quality of life and can be found in Appendix 2.

<u>Demographic profile</u>

Demographic data questions relating to gender, age, ethnic origin and occupation were recorded.

<u>Medical history</u>

The questionnaire asked respondents to record details of their medical history including current and past medical conditions and current medication.

Smoking-related knowledge

Knowledge of the health impacts of smoking was explored in the questionnaire. The participants were asked to record whether a list of medical disorders could be caused or exacerbated by smoking using a simple yes/no or don't know format.

Smoking-related attitudes

The attitude towards smoking was assessed using a five-point Likert-scale ranging from "not at all concerned" = 1 to "very concerned" = 5. The twelve statements in Table 2.3 used the smoking cessation questionnaire as developed by Manfredi et al. (2006).

Table 2.3: Smoking attitudes

Statement	Category
I am concerned about effects of smoking on my health	Health concerns
I am concerned about effects of smoking on health of others	Health concerns
People close want me to quit smoking	Social pressure to quit
I am confident with personal problems	Perceived stress
Things gone my way recently	Perceived stress
I want to cut down my smoking	Motivation
I want to quit smoking	Motivation
I intend to quit smoking	Motivation
I am confident I could refrain from smoking when angry	Situational self-efficacy
I am confident I could refrain from smoking when under pressure	Situational self-efficacy
I am confident I could cut down on my smoking	Confidence
I am confident I could quit smoking altogether	Confidence

Oral health-related quality of life

The oral health related quality of life of respondents was measured using the OHIP-14 tool (see Table 3.24, page 189), first developed in 1997 by Slade and Spencer, and subsequently found to be valid and reliable when applied to a variety of populations, and in several different languages (Bernabe and Marcenes 2010; Sanders et al. 2009; Slade et al. 2005). It contains fourteen statements, two for each of the following seven dimensions of impact of oral health: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and pain. It utilises a Likert-scale format with five possible responses ranging from “strongly disagree” to “strongly agree”.

Oral health-related behaviours

Questions regarding dental habits, including recent dental attendance patterns, frequency of toothbrushing and use of interdental cleaning aids were asked. These questions were based on those recorded in the 2009 Adult Dental Health Survey (Chadwick et al. 2011). The collection of this data allowed an assessment of the importance given to oral health by the respondents, and as the presence of a biofilm of dental plaque is related to periodontal health, data concerning oral hygiene practices was collected and correlated with periodontal treatment need (Marsh 2005).

Smoking-related behaviours

It has been demonstrated that the greater the level of dependence on tobacco an individual has, the more difficult they find it to achieve a successful quit attempt

(Zhou et al. 2009). The questionnaire therefore sought to determine the nicotine dependence of the smokers participating in the randomised controlled trial.

There are several tools available for determining nicotine dependence but the Fagerstrom Nicotine Dependence test is recommended by the Scottish Government (NHS Health Scotland and ASH Scotland 2010) and has been validated in assessing dependence and predicting relapse (Park et al. 2012; Zhou et al. 2009; Piper et al. 2006). This test was therefore selected for use in this trial and details can be found in Table 2.4.

Table 2.4: The Fagerstrom Nicotine Dependence test

Question	Criteria	Score
How soon after you wake up do you smoke your first cigarette?	Within 5 minutes	3
	6 – 30 minutes	2
	31 – 60 minutes	1
	After 60 minutes	0
If you wake during the night, do you smoke a cigarette?	Yes	1
	No	0
Which cigarette would you find it hardest to give up?	First one in morning	1
	Any other	0
How many cigarettes or roll-ups do you smoke per day?	10 or less	0
	11 – 20	1
	21 – 30	2
	31 or more	3
Do you smoke most frequently in the morning?	Yes	1
	No	0
Do you smoke if you are ill enough to spend most of the day in bed?	Yes	1
	No	0

Smokers were asked about which tobacco products they used e.g. cigarettes, roll-ups, pipes etc. using a yes/no format. They were asked to state the number of smokers with whom they shared their house. Intensity of tobacco use was assessed by inquiring at what age the participants started smoking and the number of cigarettes they consumed per day. Lifetime exposure to tobacco is reported as the “pack year” which is calculated by multiplying the number of years smoked (current age minus age on starting to smoke) by the reported quantity smoked per day (Binnie et al. 2007; Hanioka et al. 2007).

Respondents were asked if they had made any recent attempts to cut down or quit smoking, and to describe their future plans for stopping (Hanioka et al. 2007). These questions were based on those devised by Prochaska and DiClemente (1982) in their Stages of Change model, and widely used to assess motivation to quit in a population of smokers.

2.3.5.2 The clinical examination

Despite the high prevalence of periodontal diseases and the plethora of research papers investigating them, there is no standard methodology employed in the measurement of periodontal health and disease, or agreement as to the threshold at which health becomes disease (Tonetti and Claffey 2005). This complicates the comparison of results from different studies as well as the process of determining which measures to utilise when embarking on a project involving measurement of periodontal health.

After reviewing the literature it was clear that measurement of more than one variable was required to determine periodontal health. A recent systematic review of methods used to identify periodontal disease concludes that all researchers should use a measure of clinical attachment loss to allow comparison of results across studies (Savage et al. 2009). The European Association of Dental Public Health commissioned a paper to examine methodological issues in periodontal epidemiology and this recommends combining bleeding on probing, pocket depth and clinical attachment loss measurements as the principal variables (Leroy et al. 2010).

This study uses the following indicators: bleeding on probing, plaque index, pocket depth and clinical attachment loss.

Bleeding on probing

Bleeding on probing has been shown to be a strong indicator of the presence of periodontal disease, providing a reliable and verifiable outcome measure. It is recorded in this study using a dichotomous scale i.e. present or absent as this has proven to be a reliable methodology (McClanahan et al. 2001).

Plaque indices

The majority of plaque indices report the area of the tooth covered by plaque. The earliest indices developed tended to divide the tooth into thirds i.e. cervical, middle and incisal thirds and score from 0-3 dependent on the coverage of plaque (Modified plaque index of Schick and Ash, 1961; Oral Hygiene Index of Greene and Vermillion, 1964). The Visible Plaque Index of Quigley and Hein as modified by Turesky in 1970 uses the same methodology as above but discloses the plaque to make it easier to measure.

Other area-based plaque indices divide the tooth into a larger number of areas e.g. the Modified Navy Index divides the tooth into nine areas and weights results in favour of gingival plaque (Elliott et al. 1972). The axial plaque extension index and the proximal plaque extension index measure the height of disclosed plaque using a calibrated probe (Matthijs 2001).

The Plaque Index devised by Silness and Loe in 1964 sought to determine the amount of plaque present on each third of the tooth by recording the thickness of plaque accumulation.

The Ekstrand Index attempts to determine oral hygiene by introducing a measure of the length of time the plaque has been present on the tooth using two-tone disclosing solutions which differentiate between mature and immature plaque (Ekstrand 1998). O'Leary (1972) developed a simple dichotomous plaque index in which 0 indicated no plaque present and 1 indicated that plaque was present.

All of the above indices require some degree of subjectivity e.g. deciding what constitutes a third of the tooth, and, where disclosing solution is used, which proportion of the stained area represents plaque and which pellicle. Some of the indices measure the thickness of plaque and others the distribution, with or without weighting for specific sites.

Eaton et al. (1997), using the dichotomous Plaque Index, demonstrated that reliable results can be achieved in primary care by inexperienced examiners. They also showed that with regular checks it is possible to maintain intra- and inter-examiner reliability over a period of twelve months which is comparable to the duration of data collection in this current study. Galgut (1999) has demonstrated that a dichotomous scale i.e. 0 = absence of plaque and 1= presence of plaque consistently shows lower levels of plaque than an ordinal scale but the differences are small. The dichotomous plaque record used by

Galgut (1999) gives adequate information to show levels of plaque as required in this clinical trial and simplifies data analysis and thus is the chosen methodology.

<u>Pocket depth and clinical attachment loss</u>

Pocket depth was recorded from the bottom of the pocket to the gingival margin with a standardised manual probe (Periodontal Probe EN15, Dentsply Ash, batch number 62012021). All probes used in this study were from the same batch so as to minimise inaccuracies in the markings on the tine of the probes.

Clinical attachment loss represents the overall loss of periodontal attachment, both current and historical, and was measured from the bottom of the pocket to the cemento-enamel junction thus incorporating any gingival recession in the measurement.

Although some researchers have espoused the use of periodontal measurements on selected teeth only so as to reduce the time required to assess periodontal status and the quantity of data generated, this has been shown to underestimate the extent of periodontal disease present (Borrell et al. 2005; Craig et al. 2001). It was therefore decided to employ a full mouth examination to determine clinical attachment loss in this research project to maximise the quality of the data collected. Clinical attachment loss and pocket depth were recorded at six points on each tooth i.e. mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual and disto-lingual.

Verification of smoking status

Two different measures of the effectiveness of smoking cessation interventions are cited in research studies; point abstinence and continuous abstinence. Point abstinence defines success as no smoking in a pre-determined time interval e.g. in the previous one week or one month. A more stringent measure is that of continuous abstinence which measures success as no smoking over the entire study period. Both measures are reported here at the six month follow-up visit in order to facilitate comparisons with other trials and with the data collected by the Scottish Government from specialist stop smoking services. Self-report of smoking status was collected at twelve months.

As self-report of smoking habits tends to lead to under-reporting, two methods of biochemical verification were utilised in the randomised controlled trial. Measuring of carbon monoxide in expired breath is inexpensive and easily understood and helps to motivate smokers to continue their quit attempt (Bittoun 2008). However, carbon monoxide monitors can only reliably measure smoking activity for the previous 3 – 6 hours.

Cotinine is a nicotine metabolite which accurately measures actual smoking behaviour. It can be measured in urine, plasma or saliva, and can detect exposure to smoking in the previous 2-3 days (Barnfather et al. 2005).

A chairside cotinine analyzer is currently available to measure cotinine levels in urine and it was hoped that an equivalent machine for the measurement of salivary cotinine would be piloted in this study. Unfortunately, the development of the prototype took longer than anticipated and data collection had to commence before it was ready. Instead of using the chairside quantitative analyzer, saliva samples could be sent to a laboratory for cotinine analysis. However, the lack of immediate patient feedback from the laboratory analysis of saliva samples was considered to be a significant shortcoming and so alternative methods of cotinine measurement were sought.

As this is a dental based research project it was not felt appropriate to analyse cotinine in urine or blood in preference to saliva. It transpired that two brands of semi-quantitative chairside salivary cotinine measuring kits are available in the UK: SmokeScreen Saliva produced by GFC Diagnostics, and NicAlert Saliva produced by Nymox Pharmaceutical Corporation. It was decided to undertake a pilot project to assess the accuracy and acceptability of these tests to determine their fitness for use in this research project. A full description of this pilot study can be found in Appendix 3. The results found that both tests had sufficient accuracy to distinguish non-smokers, light smokers, moderate smokers and heavy smokers. Both tests proved acceptable to participants but KE found the NicAlert test easier to administer and so it was chosen for this trial.

All clinical data was recorded on the Clinical Examination form (Appendix 4).

2.3.5.3 The data collection process

At the initial visit with KE potential participants were informed of the aims of the study and provided with a Patient Information Sheet (Appendix 5). They were then allowed a week for reflection on whether or not to take part. At the following meeting they provided informed consent on the appropriate form (Appendix 6) and completed the self-administered questionnaire (Appendix 2), underwent a clinical examination and had their smoking status verified by carbon monoxide and salivary cotinine measurements (Appendix 4). All participants were then provided with an appointment to see the dental therapist.

At the first visit with the dental therapist the participant was provided with preventive advice i.e. oral hygiene instruction including toothbrushing and use of interdental aids. Routine non-surgical periodontal treatment was provided as required. At this point, randomisation was performed by an independent administrator. The dental therapist arranged an appointment for those participants assigned to the control group to see the specialist smoking cessation counsellor attached to this trial – Protocol (B).

Those participants assigned to the intervention group were retained by the dental therapist and received Protocol (A), the 5As intensive smoking cessation intervention (NHS Health Scotland and ASH Scotland 2010).

Participants in both groups continued to receive periodontal treatment and supportive care from the dental therapist as indicated by their individual treatment needs.

Six months after the pre-randomisation visit with the principal researcher, participants from both control and intervention groups returned for repeat collection of the same data recorded initially i.e. completion of the questionnaire, clinical examination and carbon monoxide and cotinine measurements.

The intensive smoking cessation intervention – Protocol (A) – combined provision of nicotine replacement therapy (NRT) and behavioural support tailored to individual needs (NHS Health Scotland and ASH Scotland 2010).

The behavioural component of the intervention allowed the participant to identify their own motivation to quit and difficulties they would face in their quit attempt. The techniques used were those of motivational interviewing which is a directive, client-centred counselling style used to encourage behaviour change (Soria et al. 2006). Participants were encouraged to set a quit date and to prepare for that date in advance. Preparation included keeping a written record of why they wished to give up. This could then be consulted in moments of temptation. Having identified their “favourite” cigarettes, they were encouraged to find a change in routine that fitted their individual circumstances to help overcome these difficult times. In keeping with the ethos of motivational interviewing (van Schayck et al. 2008), clients were encouraged to identify the sources and solutions to their own difficulties during the quit process with direction from the dental therapist.

The pharmacological component of the intervention involved providing the participant with nicotine replacement therapy (NRT). As no evidence exists to favour one presentation of NRT over another (West et al. 2000), personal choice was exercised by the participant in determining which of the following presentations were used: patch, gum, nasal spray, oral spray, sublingual tablet, lozenge or inhalator. An increase in quit rates has been demonstrated when a combination of NRT is used (Silagy et al. 2004) and so participants were offered combination therapy where appropriate. As NRT is not available in the Dental

Practitioner's Formulary, a Patient Group Direction was developed by KE in conjunction with the Lead Pharmacist and Lead Smoking Cessation Adviser of Argyll & Bute CHP. The Patient Group Direction was employed by the dental therapist and can be found in Appendix 7.

Two pharmacological interventions, bupropion and varenicline, which have been shown to increase quit rates and are not based on NRT were not offered in this study. This decision was taken as the local specialist stop smoking services do not offer these drugs routinely and discouraged their inclusion in this trial. Any participant wishing to use either of these drugs was referred to their general medical practitioner and removed from the study.

Weekly visits were arranged with the dental therapist for 6-8 weeks, as this has been shown to be the most effective and efficient time period and interval for promoting smoking cessation. The choice of nicotine replacement therapy was discussed and the presentation or combination of presentations preferred by the client was provided. At subsequent visits, changes to dosage or presentation were arranged as deemed appropriate by the dental therapist after discussion with the participant. Nicotine replacement therapy was withdrawn when the client was ready – between six and twelve weeks after starting therapy.

The weekly visits allowed the dental therapist to motivate the participant, congratulating them on their success so far, or encouraging them to continue if they had lapsed. Strategies to counteract cravings and prevent relapse were reinforced at each visit. The measurement of the level of carbon monoxide in expired breath at each visit served a twofold purpose. As well as verifying a cessation or reduction in smoking, the decreasing levels provided motivation for participants to continue with their quit attempt. Carbon monoxide is expelled from the body twenty four hours after quitting and so participants received tangible evidence of health improvements at an early stage (Bittoun 2008).

Details of the smoking cessation intervention were recorded using the Scottish Government Minimum Dataset record, allowing the results of this study to contribute to the overall picture of smoking cessation activity in Argyll & Bute CHP (see Appendix 8).

2.3.6 Ethical considerations

Ethical approval was obtained from the East of Scotland Research Ethics Service – REC reference number 10/S0501/37 (See Appendix 9). NHS Highland Research & Development Department also approved the project – R&D reference number 684 (See Appendix 10).

Potential participants were invited to meet with KE and the purpose and process of the research project was explained. They were given an opportunity to ask any questions they wished and it was made clear that a decision not to participate, or to withdraw from the project at any time, would not have any negative repercussions. Each potential participant was given a copy of the Participant Information Sheet (see Appendix 5) to take away with them and encouraged to discuss it with family and friends if they wished. Following a week for reflection, prospective participants attended a further appointment with KE and provided written consent (see Appendix 6) if they wished to participate.

2.3.7 Data Analysis

In order to facilitate data analysis, demographic data such as age and occupation were categorised. Participants were divided into younger and older age groups using a median split, whilst occupations were divided into four groups – Group 1: requiring school level qualifications only, Group 2: requiring workplace training, Group 3: requiring sub-degree level qualifications and Group 4: requiring degree level qualifications – according to the Standard Occupational Classification (Office of National Statistics 2010).

The variables which utilised Likert scales were analysed using mean scores and/or categorised data according to convention to allow comparison with results found elsewhere e.g. OHIP-14 results found in the Adult Dental Health Survey.

Nicotine dependence was calculated by assigning numerical values to participant responses according to the recommendations of Fagerstrom who devised the questionnaire (Table 2.4, page 82).

Bleeding on probing and plaque were both recorded at six sites per tooth using a dichotomous scale and so the scores of 0 or 1 were totalled and the percentage full mouth score calculated. Clinical attachment loss was presented as a mean of the total values per site, and also stratified to present percentages of participants with loss of attachment of over 4mm, over 6mm and over 9mm. This stratification allowed comparisons of the data with those found in the Adult Dental Health Survey in 2009 as their data was presented this way (White et al. 2011).

Missing data were handled by replacing them with the mean value of the variable in question.

2.3.8 Statistical analysis

All data analysis in the randomised controlled trial used the SPSS electronic statistical programme Version 16.0. Following pooling of the data from the self-administered questionnaire they were coded and entered into the SPSS database. Frequency distributions were employed to provide a basic analysis of the data. Chi-squared tests were used to analyse categorical data, whilst t-tests and Analysis of Variance (ANOVA) were used to analyse continuous data, with statistical differences between groups being determined by post hoc Scheffe tests.

Outcome measures of smoking cessation were analysed at six and twelve months and the odds ratio was calculated by dividing the number of quitters in the treatment group by the number of non-quitters in the treatment group, and dividing that figure by the number of quitters in the control group by the number of non-quitters in the control group. The smoking cessation intervention offered to the intervention group – Protocol (A) – was considered to be more effective than referral to specialist smoking cessation services – Protocol (B) – if the odds ratio was greater than 1. All participants lost to follow-up underwent an intention-to-treat analysis and were treated as non-quitters.

Pocket depths and clinical attachment loss were analysed using repeated values of analysis of variance (ANOVA) to determine any changes between baseline and follow-up at six months. Differences in periodontal outcomes between the control and the intervention group were analysed using negative binomial regression (Preshaw et al. 2005).

2.3.9 Quality Assurance

The data collected in this trial were based on validated measures where possible e.g. Fagerstrom assessment of smoking dependency and OHIP-14. The measures of periodontal health were selected following an extensive review of the literature in this area. The aim was to record the most comprehensive and appropriate level of information possible.

The smoking cessation intervention was evidence-based and followed best practice guidelines produced nationally. The dental staff involved in the project i.e. KE and the dental therapist, undertook a nationally-recognised qualification in provision of stop smoking support – “Specialist Stop-smoking Support for Individuals and Groups” delivered by Partnership Action on Tobacco and Health (PATH), a joint initiative between ASH Scotland, NHS Scotland and the Scottish Government to reduce the prevalence of tobacco use in Scotland, under the auspices of Glasgow Caledonian University. Both the researcher and the dental therapist received mentoring from the Lead Smoking Cessation Counsellor for Argyll & Bute CHP.

Selection bias was minimised by ensuring that randomisation was undertaken by an independent person. The researcher endeavoured to remain unaware of whether participants had been assigned to the control or intervention groups until after recording the post-intervention data and analysing it, thus removing detection bias. Attrition rates in both control and intervention groups were reported. All data were analysed on an “intention to treat” basis ensuring that any participants lost to follow-up were assumed to still be smokers. The most robust measure of smoking abstinence was reported i.e. continuous abstinence, alongside point prevalence of smoking in the previous seven days at six months and one year which allowed comparison with results in specialist stop smoking services in Scotland.

Verification of smoking status took place at three levels – self-report, carbon monoxide monitoring and salivary cotinine monitoring thus providing the highest level of confirmation available.

2.4 Results

2.4.0 Introduction

This chapter reports the results of the randomised controlled trial and reflects on the poor recruitment rate achieved. It will go on to explain attempts made to pinpoint the reasons for the failure of recruitment, and ultimately determine if and how it would be feasible to measure the effectiveness of a smoking cessation intervention in remote and rural dental primary care.

2.4.1 Sample

During the recruitment period from June 2011 – December 2012, a total of fourteen individuals indicated that they were interested in participating in the randomised controlled trial after they had read the Patient Information Sheet. A summary of the sample progress through the trial process can be found in Figure 2.5.

One potential participant was excluded when it transpired that she was edentulous. Of the remaining thirteen interested parties, eight failed to attend for the initial consent visit with KE. A second letter and telephone follow-up resulted in a further failure to attend. Five individuals attended the pre-randomisation visit and consented to take part in the randomised controlled trial. At this stage they completed the questionnaire, underwent a clinical examination and provided samples of expired breath and saliva for the biochemical verification of their smoking status.

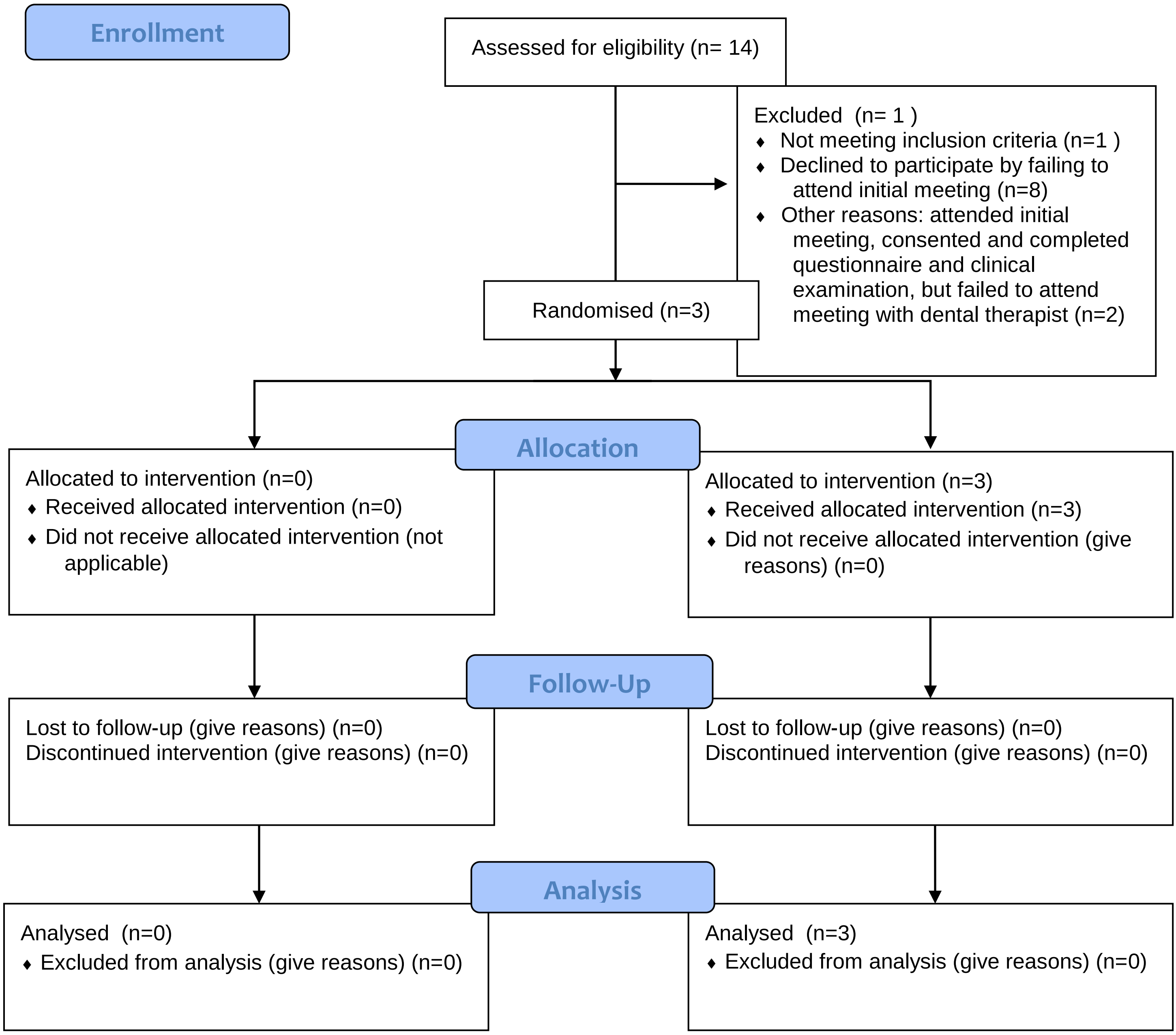
Follow-up appointments with the dental therapist were arranged at which they would receive all necessary periodontal treatment and advice and be randomised to either the control or intervention group for receipt of Protocol (A) or Protocol (B).

When the five participants were recalled at six months to repeat the data collection undertaken at the initial visit, only three participants attended, and it transpired that the remaining two individuals had not attended any of the appointments arranged with the dental therapist and therefore had not received any part of the intervention.

The random nature of the allocation process and the tiny numbers involved resulted in all three of the participants completing the trial having been allocated to the intervention group and none to the control group.

Owing to the very small sample size, results are presented as frequencies only, firstly including all five participants who attended the initial visit, and then comparisons between results for the initial visits and six month follow-up visits are presented for the three participants who completed the trial.

Figure 2.5: Study sample analysis using CONSORT 2010 Flow Diagram (www.consort-statement.org), accessed 09/11/13)



2.4.2 Demographic characteristics

Each of the five individuals consenting to participate in the randomised controlled trial was female and their ages ranged from 24 – 56 years, with a mean age of 43 years and a median age of 44 years. One of the participants described their ethnicity as gypsy traveller, with the remaining four recording that they were white British. The reported occupations of respondents were assigned to four levels of occupation according to the Standard Occupational Classification (Office of National Statistics 2010). Two of the participants were in occupations requiring sub-degree level qualifications, two were in occupations requiring school level qualifications only, and one was unemployed and her previous occupations had required only school-level qualifications.

The age range of the three participants who completed the trial was from 39 – 56 years, with a mean age of 49 years and a median age of 52 years. All reported they were white British females and two of them held occupations requiring sub-degree qualifications, whilst the third worked in an occupation requiring only school level qualifications.

2.4.3 Medical status

Three (60%) of the participants stated they were receiving treatment from their doctor and four (80%) reported they were currently taking prescribed medication. The only medical conditions reported were angina (one respondent) and blood disorders (two respondents).

In the group of respondents who completed the trial one reported receiving medical treatment, two reported taking prescribed medications, one reported having angina and two had blood disorders at the initial visit. At the six month follow-up visits, two of the three respondents reported receiving medical treatment and all three were taking prescribed medication. The reported medical conditions had not changed.

2.4.4 Smoking-related knowledge, attitudes and behaviours

Smoking-related knowledge

As part of the self-reported questionnaire, participants completed a table listing a range of medical conditions and were asked to record whether they considered the conditions to be related to smoking or not (see Appendix 2). The average frequency of correct responses over all twelve physical conditions listed was 73.3%. The frequency of correct answers can be found in Table 2.5.

Table 2.5: Knowledge of smoking-related health conditions

Smoking-related health conditions	Correct response – initial visit all 5 participants		Correct response – initial visit, 3 completers only		Correct response – follow-up visit	
	No.	%	No.	%	No.	%
Arthritis	3	60	3	100	3	100
Heart disease	5	100	3	100	3	100
Gum disease	5	100	3	100	3	100
Skin disease	2	40	0	0	2	67
Broken arm	5	100	3	100	3	100
High blood pressure	5	100	3	100	3	100
Mouth cancer	5	100	3	100	3	100
Lung cancer	5	100	3	100	3	100
Toothache	1	20	1	33	1	33
Dementia	1	20	1	33	1	33
Bronchitis	3	60	3	100	3	100
Liver disease	4	80	3	100	3	100

Smoking-related attitudes

Table 2.6 shows the mean score for each of the twelve attitudinal items for all those attending the initial visits, followed by results from the initial visits for the three participants who completed the whole trial. They were separated out in order to assess any differences in attitudes between those who completed the trial and those who did not.

Table 2.6: Smoking-related attitudes

	Smoking-related attitude	**Mean scores**	
		Initial (n=5)	Initial (n=3)
1	Concerned about effects on my health	4.4	4.0
2	Concerned about effects on health of others	4.2	4.0
3	People close want me to quit	3.6	3.7
4	I am confident with personal problems	3.4	3.0
5	Things have gone my way recently	3.0	3.0
6	I want to cut down my smoking	4.0	4.0
7	I want to quit smoking	4.4	4.7
8	I intend to quit smoking	4.4	4.0
9	Confident could refrain when angry	3.0	2.7
10	Confident could refrain when under pressure	2.6	2.0
11	Confident I could cut down	3.8	3.3
12	Confident I could quit altogether	3.6	3.3

Smoking-related behaviours

The age on starting smoking in this sample ranged from 11 – 33 years, with a mean age of 17.2 years (SD=9.0) and a median of 14 years. For the three respondents completing the trial the age on starting smoking ranged from 12 – 33 years, with a mean of 19.7 years (SD=1.16) and a median of 15 years.

Lifetime exposure to tobacco was measured using the pack-year, calculated by multiplying the number of years smoked by the number of packs smoked per day. The mean pack-years was found to be 23.6 for all five participants and 24.3 for the three completing the trial.

Nicotine dependence was measured using the Fagerstrom Nicotine Dependence test (sse Table 2.4, page 82) which gives a score of between 0 and 8. The full range of scores was found in this sample with scores of 0, 0, 5, 7 and 8 being recorded, giving a mean value of 4.0. The three respondents who attended for follow-up had a range of nicotine dependence form 0 – 7 and a mean of 4.0. All but one of the respondents shared their house with one other smoker, and one respondent shared with two other smokers. Two of the three completers lived with one other smoker and the other was the only smoker in the house.

Two of the smokers reported that they had cut down on the quantity of tobacco they consumed in the previous two months, both of them in the group that attended for follow-up. None of the respondents had tried to quit altogether or stopped for at least 24 hours in the previous two months. Four of the five respondents reported that they wished to quit smoking in the next six months, one of those who completed the trial having already set a quit date. The remaining respondent indicated that she wished to quit but not necessarily in the next six months.

Two of the three participants reported point abstinence for the previous seven days and thirty days at the six month follow-up appointment, although one had lapsed for a one month period towards the beginning of the six month duration of the trial. The remaining participant had continued to smoke throughout. The veracity of the self-reported smoking status was borne out by the changes in the salivary cotinine and carbon monoxide measurements between the initial visit and the 6 month follow-up visit. Participants 1 and 2 reduced their cotinine levels from 2.0 to 1.0, and from 4.0 to 1.0 respectively, and carbon monoxide levels fell from 5.0 to 2.0, and 12.0 to 2.0 respectively. A measurement of 0 or 1 for salivary cotinine indicates the person is a non-smoker as does a carbon monoxide measurement of 7 or under. Participant 3, who admitted continuing to smoke, actually presented increased cotinine (from 4.0 to 6.0) and carbon monoxide levels (from 14.0 to 32.0) at the follow-up visit. This reflected the fact that she had cut down her nicotine intake prior to attending for the initial visit, but has since returned to her previous level of smoking. Table 2.7 shows the mean and median values recorded for salivary cotinine and carbon monoxide at the initial and six month follow-up visits.

Table 2.7: Cotinine and carbon monoxide measurements at initial visit and 6 month follow-up

	N	Cotinine (ng/mL)			Carbon monoxide (ppm)		
		Mean	Median	SD	Mean	Median	SD
Initial visit	5	4.2	4.0	1.5	18.0	12.0	1.7
At 6 months	3	2.7	1.0	2.9	12.0	2.0	1.7

2.4.5 Oral health-related quality of life

The mean OHIP-14 score was 6.2 (SD=5.8), with a range of 2 to 16. Table 2.8 shows the total mean OHIP-14 scores and number of impacts experienced among all five participants who attended the initial visit, the three completers at the initial visit and the three completers at six months.

Table 2.8: OHIP-14 scores and number of impacts experienced

Participant number	Total OHIP-14 scores		Number of impacts experienced	
	Initial visit	At 6 months	Initial visit	At 6 months
1	5	3	2	1
2	6	3	3	2
3	2	1	1	1
4	2	N/A	1	N/A
5	16	N/A	7	N/A

All of the respondents, whether they went on to complete the trial or not, had experienced at least one of the impacts on daily living measured by OHIP-14 at least occasionally in the previous twelve months.

2.4.5 Oral health-related behaviours

Each of the respondents had attended the dental surgery in the previous twelve months, two for a routine examination and three due to problems with their teeth. Of those completing the trial, two had attended the dentist with problems and one for routine care.

Four of the respondents reportedly brushed their teeth twice per day, whilst one brushed once daily. All three of those attending for follow-up brushed twice daily. Two of the respondents did not use any form of interdental aid, but the remaining three used dental floss (3), TePe brushes (2) and woodsticks (1). Two of those using dental floss and TePe brushes went on to attend for follow-up at six months.

2.4.5 Clinical examination

- Periodontal health

<u>Bleeding on probing</u>

The mean percentage of sites displaying bleeding on probing ranged from 6% - 50%, with a mean of 25.8% across the five participants. The three participants who completed the randomised controlled trial had an initial mean percentage of sites showing bleeding on probing ranging from 11% - 50%, with a mean of 31.3%. The results at six months had reduced to a range of 0% - 24% with a mean of 8.7%.

Presence of plaque

A range of 9% - 52% of sites showing presence of plaque was found among the five participants at the initial visit, with a mean of 28.2%. Presence of plaque was found ranging from 17% - 52% of sites on the teeth of the three participants who completed the trial, with a mean result of 33.3%. An improvement was found at the six month follow-up visit when presence of plaque had reduced to a range of 1% - 26% of sites, with a mean of 9.7%.

Pocket depth and attachment loss

The mean pocket depths found in the five respondents ranged from 1.2mm – 2.3mm, a mean value of 1.9mm. When only the three participants who returned for follow-up were considered, the mean value for pocket depth was 2.2mm, with a range of 2.0mm – 2.3mm. At six month follow-up pocket depths had decreased to a mean of 1.8mm (range 1.6mm – 2.1mm).

Attachment loss over the five respondents had a mean value of 2.3mm with a range from 1.6mm – 2.6mm. When only those respondents completing the trial were included, a mean value of 2.4mm was found with a range from 2.2mm – 2.6mm. An improvement in attachment loss was found at six month follow-up with a range of 1.8mm – 2.7mm and a mean value of 2.3mm.

In order to assess the severity of periodontal disease at individual sites in the mouth, and to allow comparison with other data published among a British population, the percentage of sites with clinical attachment loss of over 4mm, over 6mm and over 9mm was calculated. At the initial visits the percentage of sites with attachment loss of greater than 4mm ranged from 1% - 10%, with a mean of 5.8%. Only one participant showed attachment loss of over 6mm (at 1% of sites) and over 9mm (at 0.5% of sites).

When initial values and follow-up values for clinical attachment loss of over 4 mm were compared in the three participants who completed the trial mean values were 7% and 3% respectively, with ranges from 3% - 10% at the initial visits and 1% - 6% at the follow-up visits.

2.5 Discussion and reflections on the PHaSCe trial

The number of participants enrolled to participate in the PHaSCe trial was extremely disappointing. The initial recruitment strategy consisted of dental staff at reception and in the dental surgery informing patients about the research project and providing anyone interested with a leaflet giving contact details for the researcher. All local general medical practitioners and heads of department in the integrated care centre where the dental practice is based were informed and supported the project. The Planning and Public Involvement Officer of Argyll & Bute CHP ensured that patient groups were aware of the project and events were held in conjunction with local specialist smoking cessation services to capitalise on national No Smoking Day and New Year’s resolutions.

On encountering difficulties in recruitment, another site was included in the study. This site was felt to be comparable to the original in many respects: the dental practice was managed by the Salaried Primary Care Dental Service of Argyll & Bute CHP and comprised three dental surgeries based in a community hospital in a small town. The same process of motivating staff to assist in recruitment was undertaken as for the Lochgilphead dental practice. However, recruitment rates did not improve following the addition of the dental department in Dunoon to the trial.

On reflection, the recruitment process for this study relied on potential participants being approached at the optimal time i.e. at the exact moment when they were prepared to attempt to quit smoking. Whilst the majority of smokers wish to quit, most are in the contemplation stage rather than in the preparation or action stages. It would therefore seem likely that smokers would require repeated prompts prior to feeling ready to avail themselves of any smoking cessation interventions on offer. It may be that smokers in this trial did not complete sufficient dental visits to reach this point, or that the dental professionals involved did not follow up their initial offer of support at subsequent visits.

It transpired that the process of recruitment itself was rather cumbersome resulting in anecdotal evidence that some potential participants sought smoking cessation support elsewhere. The enthusiastic smoker wishing to quit immediately was provided with written information about the project by their dentist or the dental receptionist which explained that they would need to be seen on three separate occasions prior to determining a quit date. Two visits with the principal researcher were required – one to discuss the purpose of the study and explain what it entailed, and the second to provide informed consent after being given at least a week to consider whether or not to participate. This was a requirement of the Research Ethics Committee. After completion of the consent process, a third appointment was made with the dental therapist who provided periodontal treatment and advice prior to contacting the study administrator to determine if the participant was to form part of the control or intervention group. It was therefore only at the fourth visit with either the dental therapist or the specialist stop smoking counsellor that participants were provided with their chosen nicotine replacement therapy and asked to set a quit date. It is felt that this process placed too heavy a burden on potential participants and contributed greatly to the poor recruitment achieved.

While the protracted nature of the recruitment process and the difficulty of approaching potential participants at the correct stage of readiness to quit undoubtedly contributed to the failure of the trial, there may have been more fundamental reasons e.g. dental patients did not believe that dental professionals had a role in smoking cessation provision. Moreover, is periodontal health a primary motivating factor for dental patients who are smokers to enter a smoking cessation programme provided in general dental practice?

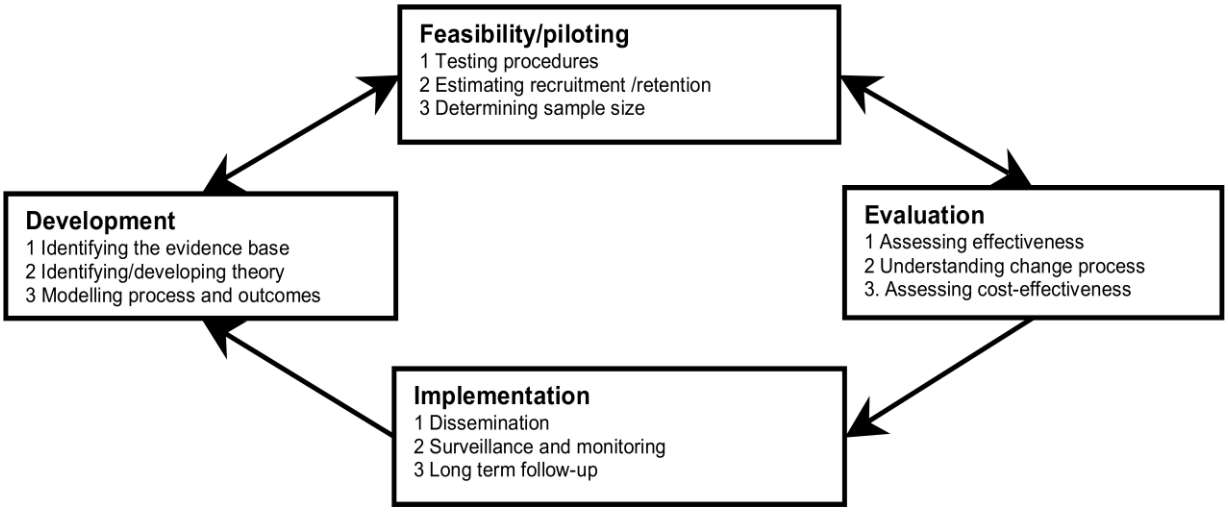
2.6 Conclusions and Recommendations

In conclusion, the issue of the recruitment process to the PHaSCe trial contributed in part to its failure. However, this may not have been the only reason for the difficulties encountered. Difficulties included a lack of an appreciation of the requirements with regard to the evidence-base and the effectiveness of smoking cessation in remote-rural primary dental care. Therefore as a first step there was as a need for a more rigorous and systematic examination of the evidence-base to highlight essential elements of a randomised controlled trial which could contribute to the success of a smoking cessation intervention in remote-rural primary dental care.

As the elements of this new approach were explored there emerged a need for modelling a smoking cessation intervention tailored to the needs of remote and rural populations of primary care dental patients. For instance, is periodontal disease a primary motivating factor for dental patients who are smokers to quit smoking tobacco? It seemed appropriate therefore to visit the Medical Research Council's Framework for Developing and Evaluating Complex Interventions (2010) to facilitate a process to allow the modelling of a smoking cessation intervention in remote-rural primary dental care. On examination of the MRC Framework it transpired that it had been developed to add structure and rigour to the development and evaluation of interventions which involve many interrelated and complex elements which do not fit well into templates for conventional trials. This indicated that the MRC Framework could indeed contribute to the development of a successful smoking cessation intervention for this study population.

Therefore, in view of these issues, it was decided to use the MRC Framework for the Development and Evaluation of Complex Interventions (Figure 2.6) to discover [1] the evidence-base and [2] collect data to model processes and outcomes from which recommendations for a feasibility study would be formulated with regard to a smoking cessation intervention for remote-rural primary dental care.

Figure 2.6 Key elements of the MRC Framework for Complex Interventions



http://www.mrc.ac.uk/Utilities/Documentrecord/index.htm?d=MRC004871

Chapter 3: Modelling a smoking cessation intervention for primary dental care in remote-rural Scotland

3.0 Introduction

3.1 Aims and objectives

3.2 Systematic literature review

3.3 Smoking and periodontal health prevalence and attitudes study in target population

3.4 Modelling a smoking cessation intervention using a structural equation model technique

3.0 Introduction

The difficulty in recruiting to the PHaSCe trial led to the need for the development of an effective smoking cessation intervention to be configured for a remote and rural area of Scotland. In order to provide structure and rigour to the development of this complex intervention, the Medical Research Council's (MRC) Framework for the Development and Evaluation of Complex Interventions was used (Figure 2.6).

The first step in the process of developing a complex intervention is to identify the evidence base. This was undertaken by conducting a systematic literature review with a meta-analysis in order to identify the existing evidence concerning research into the effectiveness of smoking cessation interventions conducted in remote and rural areas. The MRC Framework also states that any intervention must be contextualised and tailored for the population for whom it is intended. Therefore as a second step and to enable the modelling of a smoking cessation intervention it is necessary to conduct a survey to gather the relevant information from patients accessing primary dental care in Argyll & Bute CHP. The smoking and periodontal health prevalence and attitudes survey comprising a questionnaire and a basic periodontal examination identified the characteristics necessary to model a smoking cessation intervention for remote-rural primary dental care in Scotland.

3.1 Aim and objectives

<u>Aim</u>

To develop recommendations for the characteristics of a smoking cessation intervention for primary dental care in remote-rural Scotland.

<u>Research objectives</u>

3.1.1 Objective 1

To evaluate the evidence-base regarding the effectiveness of tobacco cessation interventions applied by dental professionals in remote-rural primary dental care using a systematic literature review and meta-analysis.

3.1.2 Objective 2

To determine the prevalence and risk factors for chronic periodontitis, and its impact on oral health-related quality of life in a population of registered primary care dental patients in a rural area of Scotland.

3.1.3 Objective 3

To model a smoking cessation intervention based on smoking status, periodontal health status and oral health-related quality of life collected in a sample of adults attending a general dental practice in a remote and rural area.

3.1.4 Objective 4

To recommend the characteristics of a feasibility trial for a smoking cessation intervention for primary dental care in remote-rural Scotland.

3.2 The Systematic Literature Review

3.2.0 Introduction

This section relates to research objective 3.1.1. The narrative literature review considered the prevalence, pathogenesis and risk factors for chronic periodontitis. It has identified smoking as a major risk factor for poor periodontal health, and explored the effectiveness of smoking cessation interventions in various healthcare locations, including dental settings.

Whilst evidence of the detrimental effects of cigarette smoking on general health began to emerge in the 1950s (Doll and Hill 1954), it was several decades later before the research community began to investigate how smokers could be effectively supported to quit. A Cochrane Review conducted in 2000 showed that all interventions based on behavioural and/or pharmacological support have higher success rates than unsupported quit attempts (Lancaster et al. 2000). Smoking cessation research has utilised a vast array of interventions, providers and settings, but comparatively little research has involved a dental component (Carr and Ebbert 2006).

Provision of health care in a rural location presents challenges not encountered in more urban areas. These include geographical accessibility where long distances to travel may be compounded by inadequate public transport and higher levels of poverty. In the context of smoking cessation interventions, the gold standard intervention would involve weekly support meetings for a minimum of six weeks, which in a rural area may lead to high costs in terms of time and finances (Stoops et al. 2010). Attracting healthcare providers to live and work in remote areas can also be difficult. Oral health provision is just as testing as other healthcare provision (Skillman et al. 2010).

Internationally, rural populations use tobacco in different ways to urban ones, with a preponderance of smokeless tobacco use in rural areas. For example, in the United States smokeless tobacco use is three times more prevalent in rural communities than in urban ones (Mumford et al. 2006). Smoking rates can also be higher in rural populations e.g. in the rural Appalachian mountains in Kentucky smoking prevalence was 34.4% in 2008 as opposed to 19.8% of the United States population as a whole (Stoops et al. 2010).

Specialist smoking cessation services are also more widely spread in rural areas and may lead to reduced choices regarding the type of service provided e.g. it may be impractical with the lower numbers seeking support to offer group support, which many people prefer to individual counselling (NHS Scotland and ASH Scotland 2004).

This study aims to determine the viability of evaluating the effectiveness of smoking cessation interventions in improving periodontal health in patients attending dental primary care in a remote and rural area. A systematic literature review follows which will critically appraise empirical evidence from the literature in a structured manner to identify existing evidence relating to smoking cessation activities with a dental component undertaken in rural areas.

3.2.1 Research question

The research question for the systematic literature review was developed in order to facilitate a methodical and structured search of the literature. Whilst endeavouring to delineate fixed parameters for the literature search, the research question was not so narrowly defined that potentially relevant papers would not be retrieved.

A preliminary narrative review of the literature indicated that research into smoking cessation is a recent phenomenon but that it is expanding. The Cochrane Collaboration has completed 77 systematic reviews relating to smoking cessation, only one of which involves dental smoking cessation activities (Carr and Ebbert 2012) so it would seem that there is limited evidence available relating to dental care and smoking cessation.

The narrative overview also revealed that most existing research into smoking cessation activities in a dental setting has been conducted in urban areas, and often in secondary and tertiary care. The extent to which literature existed which was relevant to a remote-rural population attending primary dental care was unclear and this led to the formulation of the research question:

"How effective are tobacco cessation interventions applied by dental health professionals in remote and rural primary dental care?"

Therefore the aim of the systematic review was:

To evaluate the evidence-base regarding the effectiveness of tobacco cessation interventions applied by dental professionals in remote-rural primary dental care using a systematic literature review and meta-analysis.

3.2.2 Study Selection Criteria

This systematic literature review involved a rigorous and methodical search of the research literature and unpublished materials exploring any tobacco-related intervention with a dental or oral health-related component undertaken in a rural area. The review not only aims to evaluate the effectiveness of stop smoking interventions undertaken in remote and rural primary dental care, but to identify their potential contribution to improving oral health, and to identify which components of the interventions are most important in achieving success. Therefore, the structured review, whilst defining selection criteria, sought not to restrict study selection to the extent that relevant material was missed.

At all stages the principles espoused by the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement have been consulted in order to maximise the rigour of the results of the systematic literature review and facilitate the critical evaluation of the evidence encountered (Moher et al. 2009).

3.2.3 Study Design

In order to capture a broad overview of relevant papers, this initial search included epidemiological surveys, cross sectional studies, cohort studies and randomised controlled trials. When seeking to evaluate the effectiveness of an intervention it is recommended that only randomised controlled trials provide sufficient rigour but the research question here encapsulates the necessity for smoking cessation activities in dental settings as well as their effectiveness, hence the decision to include a variety of study designs. Handsearching of the references of the papers identified was undertaken, and Dr. Vivian Binnie, an expert in the field of smoking cessation in the dental setting, was consulted in order to maximise the identification of relevant studies.

3.2.4 Study participants

The participants in the included studies in this systematic review were from remote-rural populations, users of tobacco in any form i.e. smokeless tobacco, cigarettes, roll-ups, cigars or pipes, and healthcare workers, including dental workers, involved in any tobacco related interventions in rural communities. No geographical limitations were applied to the search as remote-rural populations across the world face many of the same challenges, and participants of all age groups and ethnicities were included.

3.2.5 Study interventions

This search has included any cross-sectional population study, cohort study or randomised controlled trial relating to the prevalence of tobacco use and/or oral disease, as well those examining the effectiveness of tobacco-related interventions delivered by a dental care professional i.e. dentist, dental therapist, dental hygienist, dental nurse or dental administrative staff. Studies which were undertaken in non-dental settings such as colleges or schools, as well as those in dental clinics, have been included provided that any part of them involved dental personnel.

The intensity of any tobacco cessation intervention utilised in the research process did not preclude inclusion i.e. brief and intensive interventions were equally valid for the purposes of this systematic literature search. Likewise, interventions may or may not have included a member of the dental team providing nicotine replacement therapy or other pharmacotherapy, counselling or provision of self-help materials.

All methods of delivery of a tobacco cessation intervention were also considered e.g. face-to-face delivery, telephone delivery or internet-based support. Studies comparing one tobacco intervention to another, as well as comparing an intervention to usual or no care were included in this review.

3.2.6 Outcome measures

Outcome measures sought in this systematic literature review included prevalence data for tobacco use and oral disease, and any measures of changes in these outcomes following tobacco use cessation interventions. Studies exploring the effectiveness of educational interventions on tobacco use prevalence were also included. Tobacco use cessation outcomes measured by self-report alone tend to overestimate success of the intervention and so data based on studies using biochemical verification of quitting using carbon monoxide or cotinine measurements are more robust (Rebagliato 2002). Despite this, studies were included whether or not biochemical verification was employed. Studies measuring either point prevalence of abstinence, usually defined as no tobacco use in the previous seven or thirty days, or the stronger measure of continuous abstinence were included. For smoking cessation outcomes only studies which provided follow-up data for a minimum of six months are included, as these are thought to more closely correspond to long-term abstinence than those following up for a shorter duration (Carr and Ebbert 2006).

3.2.7 Search Strategy

3.2.7.1 Search terms

In the process of conducting the narrative literature review seen in Chapter 2 it became clear that several terms were used to denote tobacco cessation and tobacco cessation interventions. The same is true when identifying dental –related terms and so an initial list of key words was developed in an attempt to capture all relevant data. The key words used are shown in Table 3.1.

Table 3.1 Key words related to tobacco cessation and oral disease

Tobacco-related terms	Dental-related terms
Tobacco/nicotine/smoking control	Dentist
Tobacco/nicotine/smoking prevention	Dental
Tobacco/nicotine/smoking abstinence	Oral
Tobacco/nicotine/smoking cessation	Dental/oral health
	Oral medicine
	Periodontal/periodontitis

MeSH (Medical Subject Headings) is a thesaurus of controlled vocabulary devised and updated by the United States National Library of Medicine. MeSH descriptors are used in electronic search databases such as MEDLINE and PubMED. When MeSH is applied to terms such as those in Table 3.2 it provides a comprehensive list of related terms thereby maximising the power of the search. The final search terms identified following this process can be seen in Table 3.2.

Table 3.2 Search terms

((dentist? or dental or "oral medicine" or dentistry or "oral hygiene" or Dentists or Dental staff or Oral health or periodont$) and (Smoking Prevention & Control or Smoking Cessation or "Tobacco Use Cessation") or ((Smok$ or tobacco$ or nicotine$ or cigar$) and (cessation$ or quit$ or abstinence$)) or antismok$)) and rural af.

3.2.7.2 Data Sources

The following electronic databases were used in this systematic literature search from the date of their inception until June 2013, with no language restrictions applied:

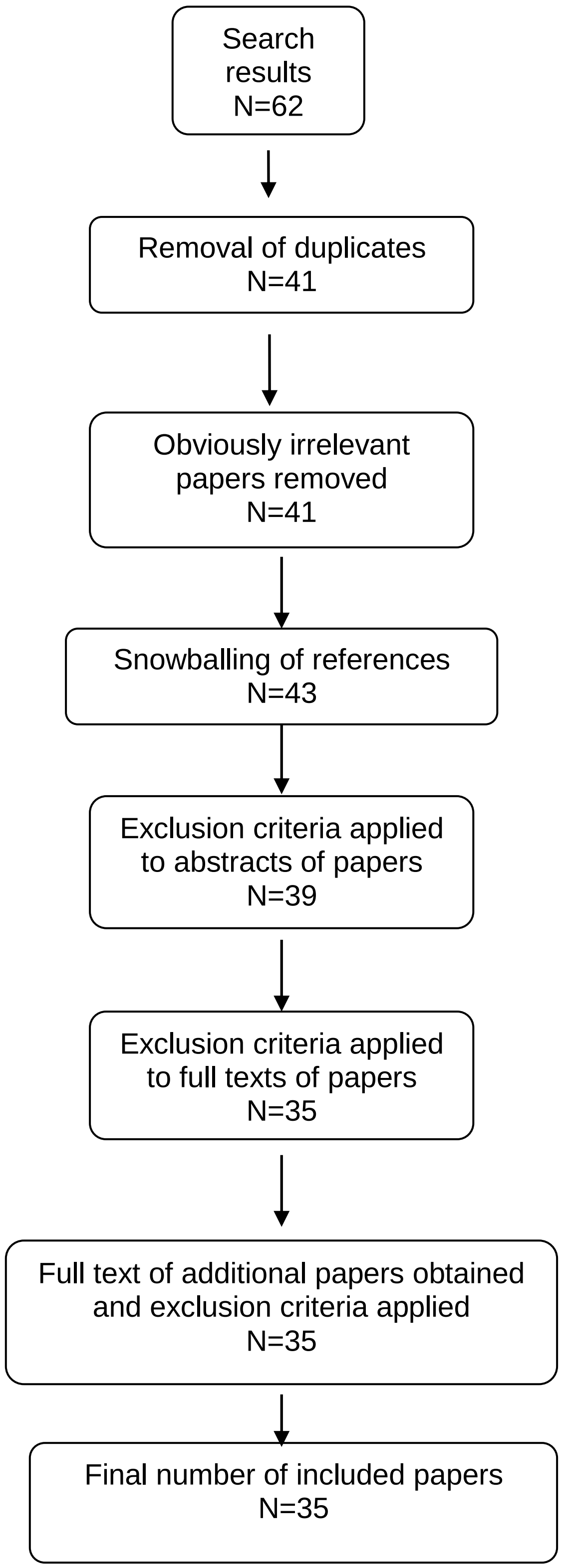
- The Cochrane Central Register of Controlled Trials (CENTRAL) 2013, Issue 1
- MEDLINE (1966 – June 2013)
- EMBASE (1988 – June 2013)
- CINAHL (1982 – June 2013)
- Healthstar (1975 – June 2013)
- ERIC (1967 – June 2013)
- PsycINFO (1984 – June 2013)
- National Technical Information Service database (NTIS, 1964 – June 2013)
- Dissertation Abstracts Online (1861 – June 2013)
- Database of Abstracts of Reviews of Effectiveness (DARE, 1995 – June 2013)
- Web of Science (1993 – June 2013)

These databases comprise literature which has been peer-reviewed thus ensuring a degree of confidence in the rigour of the publications they contain. The exception is the ERIC database which in addition to peer-reviewed material contains unpublished research material and conference papers etc. In this case no relevant data was identified in this database.

3.2.8 Search results

When the search terms defined in Table 3.2 were entered into each of the databases sixty-two papers were identified. After removing duplicate papers, 41 studies remained. References on all included papers were examined and 2 further papers were identified. An expert in the area (Dr. Vivian Binnie, Clinical Senior University Teacher) was contacted in order to ensure the search results were as comprehensive as possible. No further papers were identified from this source. Figure 3.1 shows the process of search selection.

Figure 3.1: Review process



3.2.9 Study Selection

Forty one records were retrieved from the electronic databases and a further 2 records were added following handsearching of the references on the 41 identified papers. Abstracts of all 43 papers were screened by the researcher and an experienced hospital-based librarian (JS) to ensure that they did indeed meet the criteria for inclusion. A systematic and consistent approach to determine inclusion was facilitated by use of the exclusion criteria checklist found in Appendix 11.

Full text articles were procured for those papers which appeared to meet the inclusion criteria following this initial analysis, and also for those for which it was unclear from the abstract whether inclusion was warranted. At this stage all papers were reviewed by KE, the librarian (JS) and supervisors (RF and AFH) practised in conducting systematic literature reviews. Again, the exclusion criteria checklist in Appendix 11 was employed with the aim of systematising the process.

All 43 studies identified using the search strategy above were analysed during a panel discussion to verify that they met the inclusion criteria, and a final decision made on which papers to include.

Details of these 43 papers considered and the reasons for their inclusion or exclusion can be found in Appendix 12. A total of 35 papers remained after performing this detailed analysis.

3.2.10 Data extraction

With a total of 35 papers included in this systematic literature review it was important that a methodical approach was taken to the retrieval of data. To facilitate this, a data extraction checklist was developed and applied in the process of examining each of the papers. The data extraction checklist can be found in Appendix 13, and is based on the STROBE checklist of items that should be included in reporting of observational studies (Appendix 14) and the CONSORT checklist for the reporting of randomised controlled trials (Appendix 15) (Moher et al. 2010; Schultz et al. 201; von Elm et al. 2008). It is presented in two sections, with Section 1 being applicable to all included studies, and Section 2 applying only to the five randomised controlled trials.

3.2.11 Data synthesis

The data derived from the observational studies included in this systematic literature review are summarised in a narrative presentation due to the heterogeneity of the study designs and outcomes which precluded a statistical synthesis of their findings. The descriptive synthesis of the data is presented according to the study design employed, the study participants and the outcomes sought.

As the majority of studies included in this systematic literature review are observational, it was not possible to synthesise all the findings using statistical techniques. However, the five randomised controlled trials identified allowed the statistical findings they produced to be displayed in a meta-analysis. The meta-analysis can be seen in Figure 3.4 on page 161 which follows a descriptive analysis of the data.

3.2.12 Characteristics of included papers

It is clear from the papers included in this literature search that interest in the area of tobacco cessation is a relatively recent phenomenon as the earliest papers identified were from the 1990s, and almost three quarters were published from 2000 onwards.

Over half of the research included was conducted and published in the United States (21 papers), followed by India (6 papers), Canada (2 papers) and one paper each from Iran, Japan, Sudan, Sweden, Tanzania, Thailand, Ukraine and Vietnam.

The study designs of the included papers comprised six educational interventions, twenty-one surveys which examined knowledge attitudes and practices of healthcare workers (8) and rural dwellers (13), three cohort studies and five randomised controlled trials.

3.2.13 Results

Nine surveys of the prevalence of tobacco use were included in the literature review, three of which were conducted in India among different age groups. Jayakrishnan et al. found that 8% of 11 – 15 year olds used tobacco daily with prevalence increasing with age (Jayakrishnan et al. 2011). In a group of older adolescents (15 – 19 year olds), Dongre et al. (2008) found that 68% of males and 12% of females had used tobacco in the previous 30 days, 72% of females using snuff to clean their teeth. Prevalence of daily tobacco use was found to be 18% among a rural adult population in India with the most common reason for starting use of smokeless tobacco being to relieve toothache (Daniel et al. 2008).

In a rural Californian population with an average age of 16 years, Ellison et al (2006) found a smoking prevalence of 50% of whom 32% were daily smokers. Over half of the smokers had attempted to quit but failed. Walsh et al. (1999) found similar prevalence of smokeless tobacco use in college students in rural California. Forty percent of American Indian adults were found to be smokers in a study conducted by Hodge et al in 1995, and alarmingly, there was little appreciation of the health impacts smoking causes.

A survey among 20-year-olds in Japan found similar, high rates of smoking in rural and urban populations, with 68% of males and 49% of females being smokers (Seki et al. 2004). In Tanzania, contrary to expectations, smoking prevalence was found to have fallen from 17% in 1999 to 13% in 2001 among university students, and the rates were identical independent of whether their origins were urban or rural (Astrom and Masalu 2001). Rates of tobacco use were found to be much lower amongst females than males among adults in rural Sudan, with smokeless tobacco use of 3% compared with 34% and cigarette smoking among women at 1% compared with 12% of men (Idris et al. 1998).

A survey of knowledge regarding oral cancer conducted among patients referred to a dental hospital in Iran found that only 16% knew that smoking was a risk factor (Pakfetrat et al. 2010). In rural India village dwellers underwent an oral examination and 6% were found to have suspicious oral lesions. Odds ratios of 3.06 and 4.42 were reported for bidi smokers and hookah smokers respectively for suspicious lesions as opposed to non-smokers (Dangi et al. 2012).

In a cross-sectional study, Chatrchaiwiwatana et al. (2009) interviewed and examined rural-dwelling males in Thailand and confirmed that smoking tobacco is a risk factor for periodontal disease with an odds ratio for periodontitis of 1.62 for smokers compared with non-smokers. Do et al established a dose-response relationship between smoking and periodontal ill-health in a middle-aged Vietnamese population, with an odds ratio for periodontitis of 7.2 for smokers over non-smokers (Do et al. 2003).

In a 10-year prospective cohort trial conducted in Sweden, Paulander et al. (2004) investigated risk factors for periodontal bone loss and found smoking to be the most potent risk factor with a risk ratio of 3.2. Gupta et al. reported findings from a 10-year cohort study investigating the effects of tobacco cessation on oral soft tissue lesions at both 8 and 10 years (Gupta et al. 1990; Gupta et al. 1995). Their findings showed a significant drop in incidence of leukoplakia post quitting with an incidence ratio of 0.31. All other mucosal lesions had a substantial drop in incidence with the exception of lichen planus (Gupta et al. 1995).

One of the educational intervention studies demonstrated that patient educational materials available in a university dental school were appropriate for readability, quality and content (Weiner and Weiner 2011). Jenkins and Geurink (2006) introduced a comprehensive school-based oral health programme in a rural area of Texas which included a smoking cessation component. Knowledge amongst both children and school staff increased as a result of this intervention. Two of the educational interventions were pilot projects aimed at adolescents (Semer et al. 2005; DeMoss et al. 1997) and they explored mechanisms by means of which participants could be recruited to tobacco cessation programmes. Semer et al.

focussed on cigarette smokers and the impact of smoking on faster aging and poor oral health to motivate these young smokers to quit. Over half of the target group of smokers enrolled in the stop smoking programme. DeMoss et al. explored preventive strategies for smokeless tobacco use and found their programme to be feasible and acceptable to the target audience.

The remaining educational interventions targeted dental personnel and aimed to increase their tobacco cessation activities. Walsh et al. (2012), compared self-study packages with workshop-based smoking cessation training, with or without dentist reimbursement, and found that reimbursement had no effect on subsequent attitudes and practices related to smoking cessation. Workshop training had a greater impact on smoking cessation activities than self-study, but both had a positive effect. The dental involvement in the paper by Norman et al. 1990, consisted only of being provided with patient educational literature and stop smoking kits for distribution to patients who smoked. In this programme aimed at reducing cardiovascular disease, the main outcome was increased awareness and this was achieved although the dental contribution did not result in many successful quit attempts.

Among the surveys included in this systematic literature review are three which examine the smoking cessation activities being undertaken in dental surgeries. Morgan et al. concluded that the majority of dentists ask patients about their tobacco use and offer some advice but they are not confident with respect to tobacco cessation and rarely refer patients to stop smoking services (Morgan et al. 2011). Just under half of respondents (46%) in a questionnaire survey of dental professionals in Canada reported asking patients if they smoked, advising them about the health benefits of quitting and assessing their motivation to quit. However, fewer than 10% went on to provide a smoking cessation intervention for patients who smoked (Brothwell and Armstrong 2004). Jennett et al. explored the characteristics of dental offices to determine which were most likely to accept change and introduce smoking cessation activities. They found that those surgeries which already focussed on preventive strategies, had innovative approaches to dental provision and who worked in small rather than large teams were most likely to adopt smoking cessation activities (Jennett et al. 1998). A survey of physicians' smoking cessation activities in rural and urban settings in Ukraine revealed that those who smoked themselves, who are younger, and those who are based in rural areas were least likely to provide smokers with advice to quit (Squeir et al. 2006). Campbell et al. (1999) revealed a divergence in views between patients and dental practitioners' expectations in respect of smoking cessation, with 59% of dental patients believing dentists should routinely offer smoking cessation support, whilst only 38% of dentists thought patients would expect this.

The knowledge, attitudes and practices of dentists in relation to smoking cessation activities were compared with other healthcare professionals in a rural area of Wisconsin (Block et al. 1999). They found that dentists were much less confident in and supportive of providing tobacco interventions, and more likely to cite barriers than other healthcare professionals. Zanis et al. (2008) used a different approach to assess the level of smoking cessation activity being undertaken in healthcare settings by surveying young patients who were smokers. Dentists proved to be significantly less likely to broach the subject of quitting with smokers than physicians (52% compared with 66%). Prokhorov et al.

surveyed healthcare providers and educators in rural US states about smokeless tobacco use and found that not all dentists were aware of its oral health implications, and that dentists were unwilling to repeatedly ask patients about smokeless tobacco use or refer on to specialist services as they thought patients would become offended (Prokhorov et al. 2002).

This systematic literature review has identified five randomised controlled trials, all of which were conducted in rural areas of the United States. The first randomised controlled study included was published in 2002 and the most recent in 2010. All five included studies were conducted in the United States. The inclusion criteria would have allowed studies conducted in a wide variety of settings; private and public dental practices, secondary and tertiary care dental facilities and any community setting where dental involvement in a tobacco cessation intervention had been delivered, however all five studies identified were undertaken in rural Californian high schools, colleges and universities. The participants in all of the included studies were young male users of smokeless tobacco who attended either high school (Walsh et al. 2010; Walsh et al. 2003; Gansky et al. 2002) or college (Gansky et al. 2005; Walsh et al. 1999). The age group for the high school students was 14 -19 years and for college students, 18 - 25 years.

All of the included studies gave results for smokeless tobacco cessation as this was the focus of the intervention in all five papers. This reflects the high prevalence of smokeless tobacco use in rural areas of the United States (Mumford et al. 2006). No studies involving interventions targeting smoked tobacco were identified for inclusion.

Three of the included studies (Walsh et al. 2010; Gansky et al. 2005; Walsh et al.1999) used self-report via questionnaires only to verify tobacco use cessation. The other two studies (Walsh et al. 2003; Gansky et al. 2002) collected saliva samples from all participants at the initial visit and at one year, and conducted a salivary cotinine assay on 8% of the results. As participants were unaware of whether or not their saliva would be analysed this increased the robustness of the verification of tobacco use status.

A minimum length of follow-up of participants was set as six months and all studies included exceeded this minimum standard. One study followed participants for two years (Gansky et al. 2002), whilst the remaining four (Walsh et al. 2010; Gansky et al. 2005; Walsh et al. 2003; Walsh et al. 1999) included results from a twelve month follow-up period.

All the studies included in this review used either point prevalence of tobacco use abstinence or continuous abstinence from tobacco as outcome measures. While some researchers report point prevalence of tobacco use cessation as no tobacco use at all in the previous seven days, Walsh et al. (1999); Gansky et al. (2002); Gansky et al. (2005) and Walsh et al. (2010) used a more robust period of thirty days of no tobacco use to define point prevalence. Walsh et al. (2003) reports on continuous abstinence from tobacco use over the twelve month trial period of the study. Continuous abstinence is considered to be the gold standard measure to be used in examining the effectiveness of tobacco cessation interventions.

The control group in each of the included studies received undefined “usual care” or no intervention. The five included studies compared one intervention group with a control group. All interventions taking place in a dental setting were delivered by dentists or dental hygienists.

All of the smokeless tobacco cessation interventions included a peer-led component, based on the Diffusion of Innovation Theory (Rogers 1995) or cognitive social learning theory (Bandura 1986). This involved screening and discussion of an educational video and slides of oral lesions related to smokeless tobacco use, and discussion of the marketing strategies of smokeless tobacco companies. This was followed by an oral examination, conducted in three studies by dentists or dental hygienists (Walsh et al. 2003; Gansky et al. 2002; Walsh et al. 1999) and in the others by specially trained school nurses (Walsh et al. 2010) or trained accredited athletic coaches (Gansky et al. 2005). During the oral examination there was a demonstration of any tobacco related oral lesions in the student’s mouth followed by oral health-related advice to quit. Self-help materials and face-to-face or telephone counselling was also provided. Only one of the interventions described in the included studies involved the provision of nicotine replacement therapy – Walsh et al. (1999) offered nicotine chewing gum to potential quitters.

On the whole, drop-out rates in these five studies were found to be similar in both control and intervention groups although the actual percentage drop-out rate varied from 10% (Gansky et al. 2002) to 28% (Walsh et al. 2010).

The studies conducted by Gansky et al. (2002), Walsh et al. (2003) and Gansky et al. (2005) recruited all high school baseball team members regardless of their tobacco use status, whereas Walsh et al. (2010) and Walsh et al. (1999) included only those students who reported using smokeless tobacco in the previous 30 days. Smokeless tobacco users were included in all five studies regardless of their motivation to quit tobacco use.

As randomised controlled trials offer the only study design robust enough to determine the effectiveness of an intervention, it was decided to examine the five randomised controlled trials identified in the first part of the search using the CONSORT checklist (Moher et al. 2010) (see Appendix 13) and undertake a meta-analysis. This is in line with Cochrane Collaboration guidance for assessing the effectiveness of an intervention (Needleman et al. 2010).

The effectiveness of the interventions studied were evaluated using the odds ratio which was calculated via the following equation: (number of quitters in treatment group/number of tobacco users in treatment group)/(number of quitters in control group/number of tobacco users in control group). An odds ratio greater than 1 indicated that members of the intervention group were more successful in quitting than those in the control group. The Mantel-Haenszel method, a fixed effect model, was used to give a pooled weighted average of odds ratios, with a confidence interval of 95% (Carr and Ebbert 2006).

3.2.14 Study Quality Assessment

In order to maximise the value of this systematic literature review all studies have undergone a process of critical appraisal before inclusion. Particular attention has been paid to ensuring an adequate sample size, lack of bias, failures of randomisation or sampling and numbers of dropouts. At all stages the principles described in the PRISMA statement have been followed (Moher et al. 2009).

Quality assessment tools have been used to ensure systematic appraisal of the quality of studies included and how they have been reported (see Appendices 14 and 15). The process of quality assessment of the literature review of observational studies using the STROBE checklist (von Elm et al. 2008) is summarised in Appendix 16. The equivalent quality assessment of the randomised controlled trials utilising the CONSORT checklist (Moher et al. 2010) is summarised in Appendix 17. Detailed analysis of quality parameters of the five included randomised controlled trials can be found in Table 3.3.

Table 3.3.0: Detailed quality analysis of randomised controlled trials

Study ID	Methods	Participants	Interventions	Outcomes	Notes
Author's name: Walsh et al. **Year:** 2010	**Study design:** Randomised controlled trial **Method of randomisation:** Cluster by high school **Method of allocation:** Stratified by size of school Selected from list of eligible schools **Exclusions post randomisation**: None reported **Losses of follow-up/ withdrawals:** Intervention group 48% Control group 34% **Sample size calculations:** 150 students from 40 schools needed to show 90% power to detect significant difference in quit rate of 15% in intervention group versus 5% in control group **Intention to treat analysis:** Yes, those lost to follow-up assessed as non-quitters	**Country:** United States **Setting:** Rural California High Schools **Total number:** 41 schools 4731 students **Age:** 14 – 19 years **Sex:** Male **Inclusion criteria:** Consent from parents **Exclusion criteria:** None given	**Interventions:** Peer-led education session Oral examination School nurse-led small group counselling sessions **Control:** No intervention **Duration of study:** Twelve months	**Primary outcome:** Point prevalence of abstinence from smokeless tobacco use in previous 30 days **Secondary outcomes**: Initiation rate for smokeless tobacco use among baseline non-users	Verification of tobacco use status was by self-report only. No significant difference was found between control and intervention groups for either ST cessation or initiation. However, cessation rates were significantly higher (62% versus 36%, p=0.019) in the intervention groups when comparing those who used ST only i.e. did not smoke tobacco as well, with the control group.

Walsh et al. 2010 (Table 3.3.0)

<u>Assessment of bias</u>

Selection bias
Was allocation of participants to groups concealed until after interventions were allocated?

Unclear – high schools were randomly allocated, but not enough details given

Performance bias
Were the recipients of care unaware of their assigned intervention (blinded)?

No, not possible as either received intervention or not.

Were persons providing care unaware of their assigned intervention (blinded)?

No, not possible as either provided intervention or not.

Detection bias
Were persons assessing care unaware of their assigned intervention (blinded)?

Yes, data was analysed without knowledge of allocated group.

Attrition bias
Were rates of follow-up similar in the comparison groups?

Intervention group 48% dropout among smokeless tobacco users, control group 34% dropout among smokeless tobacco users

Was the analysis “intention-to-treat” (were all patients analysed as randomised)? Yes

Outcome	Time (months)	Intervention (observed)	Intervention (total)	Control (observed)	Control (total)
Retention	12	119	229	151	229
ST use point prevalence quit 30 days	12		64 28%		59 26%
		p>0.05; OR=1.12, 95% CI, 0.74 – 1.69			

Table 3.3.1: Detailed quality analysis of randomised controlled trials continued

Study ID	Methods	Participants	Interventions	Outcomes	Notes
Author's name: Walsh et al. **Year:** 2003	**Study design:** Randomised controlled trial **Method of randomisation:** Cluster by high school **Method of allocation:** Stratified by prevalence of smokeless tobacco use and size of baseball team **Exclusions post randomisation**: Less than 20% prevalence of smokeless tobacco use in team **Losses of follow-up/ withdrawals:** Intervention group 23% Control group 15% **Sample size calculations:** 25/school and 28% prevalence of smokeless tobacco use, 334 students from 44 schools needed to show 10% cessation in intervention group versus 1% in control group **Intention to treat analysis:** Yes	**Country:** United States **Setting:** Rural California High Schools **Total number:** 1084 **Age:** 15 – 19 years **Sex:** Male **Inclusion criteria:** Baseball team member Consent from parents **Exclusion criteria:** Smokeless tobacco use too low	**Interventions:** Peer-led education session Oral examination Dental hygienist-led small group counselling sessions **Control:** No intervention **Duration of study:** Twelve months	**Primary outcome:** Continuous abstinence from smokeless tobacco use **Secondary outcomes**:	Verification of tobacco use status was by self-report but at initial visit and one-year follow-up all participants had a saliva sample collected and 8% of these were analysed. This demonstrated that 8% of those claiming to be non-tobacco users had salivary cotinine levels showing tobacco use.

Walsh et al. 2003 (Table 3.3.1)

<u>Assessment of bias</u>

Selection bias
Was allocation of participants to groups concealed until after interventions were allocated?

Unclear – high schools were randomly allocated, but no details given

Performance bias
Were the recipients of care unaware of their assigned intervention (blinded)?

No, not possible as either received intervention or not.

Were persons providing care unaware of their assigned intervention (blinded)?

No, not possible as either provided intervention or not.

Detection bias
Were persons assessing care unaware of their assigned intervention (blinded)?

Yes, data was analysed without knowledge of allocated group.

Attrition bias
Were rates of follow-up similar in the comparison groups?

Intervention group 23%, control group 15%

Was the analysis "intention-to-treat" (were all patients analysed as randomised)? Yes

Outcome	Time (months)	Intervention (observed)	Intervention (total)	Control (observed)	Control (total)
Retention	24	109	141	141	166
ST use continuous abstinence (CA)			38 27% CA		23 14% CA
		p=0.02, OR=2.29, 95% CI, 1.36 – 3.87			

Table 3.3.2: Detailed quality analysis of randomised controlled trials continued

Study ID	Methods	Participants	Interventions	Outcomes	Notes
Author's name: Gansky et al. **Year:** 2002	**Study design:** Randomised controlled trial **Method of randomisation:** Cluster by high school **Method of allocation:** Stratified by prevalence of smokeless tobacco use and size of baseball team **Exclusions post randomisation**: Less than 20% prevalence of smokeless tobacco use in team **Losses of follow-up/ withdrawals:** Intervention group 13% Control group 10% **Sample size calculations:** 25/school and 28% prevalence of smokeless tobacco use, 334 students from 44 schools needed to show 10% cessation in intervention group versus 1% in control group **Intention to treat analysis:** Yes	**Country:** United States **Setting:** Rural California High Schools **Total number:** 1084 **Age:** 15 – 19 years **Sex:** Male **Inclusion criteria:** Baseball team member Consent from parents **Exclusion criteria:** Smokeless tobacco use too low	**Interventions:** Peer-led education session Oral examination Dental hygienist-led small group counselling sessions **Control:** No intervention **Duration of study:** Twenty four months	**Primary outcome:** Continuous abstinence from smokeless tobacco use **Secondary outcomes**:	Verification of tobacco use status was by self-report but at initial visit and one-year follow-up all participants had a saliva sample collected and 8% of these were analysed. This demonstrated that 8% of those claiming to be non-tobacco users had salivary cotinine levels showing tobacco use.

Gansky et al. 2002 (Table 3.3.2)

<u>Assessment of bias</u>

Selection bias
Was allocation of participants to groups concealed until after interventions were allocated?

Unclear – high schools were randomly allocated, but no details given

Performance bias
Were the recipients of care unaware of their assigned intervention (blinded)?

No, not possible as either received intervention or not.

Were persons providing care unaware of their assigned intervention (blinded)?

No, not possible as either provided intervention or not.

Detection bias
Were persons assessing care unaware of their assigned intervention (blinded)?

Yes, data was analysed without knowledge of allocated group.

Attrition bias
Were rates of follow-up similar in the comparison groups?

Intervention group 13%, control group 10%

Was the analysis "intention-to-treat" (were all patients analysed as randomised)? Yes

Outcome	Time (months)	Intervention (observed)	Intervention (total)	Control (observed)	Control (total)
Retention	24	123	141	149	166
ST use continuous abstinence (CA)	24		32 23% CA		21 13% CA
		p=0.02, OR=2.05, 95% CI, 1.1 – 3.78			

Table 3.3.3: Detailed quality analysis of randomised controlled trials continued					
Study ID	Methods	Participants	Interventions	Outcomes	Notes
Author's name: Walsh et al. **Year:** 1999	**Study design:** Randomised controlled trial **Method of randomisation:** Cluster by high school **Method of allocation:** Stratified by prevalence of smokeless tobacco use and size of baseball team **Exclusions post randomisation**: None recorded **Losses of follow-up/ withdrawals:** Intervention group 10% Control group 5% **Sample size calculations:** 23/college over 16 colleges to give 314 smokeless tobacco users needed to show 10% cessation in intervention group versus 1% in control group **Intention to treat analysis:** Yes	**Country:** United States **Setting:** Mixed Rural & Urban colleges With baseball and football teams **Total number:** 360 **Age:** 18 – 25 years **Sex:** Male **Inclusion criteria:** Smokeless tobacco user **Exclusion criteria:** Smokeless tobacco use too low	**Interventions:** Oral examination Dental hygienist-led small group counselling sessions Provision of nicotine gum 2mg **Control:** No intervention **Duration of study:** Twelve months	**Primary outcome:** Smokeless tobacco point abstinence for 30 days. **Secondary outcomes**:	Self-report only

Walsh et al. 1999 (Table 3.3.3)

Assessment of bias

Selection bias
Was allocation of participants to groups concealed until after interventions were allocated?

Unclear – high colleges were randomly allocated, but no details given

Performance bias
Were the recipients of care unaware of their assigned intervention (blinded)?

No, not possible as either received intervention or not.

Were persons providing care unaware of their assigned intervention (blinded)?

No, not possible as either provided intervention or not.

Detection bias
Were persons assessing care unaware of their assigned intervention (blinded)?

Yes, data was analysed without knowledge of allocated group.

Attrition bias
Were rates of follow-up similar in the comparison groups?

Intervention group 10%, control group 5%

Was the analysis “intention-to-treat” (were all patients analysed as randomised)? Yes

Outcome	Time (months)	Intervention (observed)	Intervention (total)	Control (observed)	Control (total)
Retention	12	154	171	179	189
ST use point abstinence for 30 days	12		60 23% PA		30 13% PA
		P<0.001, OR=2.69, 95% CI, 1.62 – 4.44			

Table 3.3.4: Detailed quality analysis of randomised controlled trials continued

Study ID	Methods	Participants	Interventions	Outcomes	Notes
Author's name: Gansky et al. **Year:** 2005	**Study design:** Randomised controlled trial **Method of randomisation:** Cluster by college **Method of allocation:** Stratified by prevalence of smokeless tobacco use **Exclusions post randomisation**: None given **Losses of follow-up/ withdrawals:** Intervention group 21.3% Control group 21.2% **Sample size calculations:** 650 smokeless tobacco users required for 0.15 intervention group versus 0.05 control group giving 90% power. **Intention to treat analysis:** Yes	**Country:** United States **Setting:** College baseball teams **Total number:** 637 **Age:** 18 – 25 years **Sex:** Male **Inclusion criteria:** Baseball team member Consent from parents **Exclusion criteria:** None given	**Interventions:** Peer-led education session Oral examination Dental hygienist-led small group counselling sessions Athletic coach group sessions **Control:** Usual care **Duration of study:** Twelve months	**Primary outcome:** Smokeless tobacco use point abstinence for 30 days **Secondary outcomes**:	Self-report only

Gansky et al. 2005 (Table 3.3.4)

Assessment of bias

Selection bias
Was allocation of participants to groups concealed until after interventions were allocated?

Unclear – colleges were randomly allocated, but no details given

Performance bias
Were the recipients of care unaware of their assigned intervention (blinded)?

No, not possible as either received intervention or not.

Were persons providing care unaware of their assigned intervention (blinded)?

No, not possible as either provided intervention or not.

Detection bias
Were persons assessing care unaware of their assigned intervention (blinded)?

Yes, data was analysed without knowledge of allocated group.

Attrition bias
Were rates of follow-up similar in the comparison groups?

Intervention group 21.3%, control group 21.2%

Was the analysis "intention-to-treat" (were all patients analysed as randomised)? Yes

Outcome	Time (months)	Intervention (observed)	Intervention (total)	Control (observed)	Control (total)
Retention	12	225	285	277	352
ST use point abstinence for 30 days	12		103 36% PA		130 37% PA
		p>0.05, OR=0.98, 95% CI, 0.71 – 1.35			

All studies provided sufficient data to allow analysis by an intention to treat methodology i.e. all participants lost to follow up were deemed to be continuing tobacco users, thereby minimising the risk of bias. Drop out rates between control and intervention groups were analysed to identify any possible bias. Studies providing data on continuous tobacco abstinence were deemed to be more robust than those giving point prevalence data only, as were those where tobacco status was verified biochemically as opposed to self-report only.

Recruiting methodology was examined as some studies recruited only those tobacco users wishing to quit where others recruited all tobacco users. Where reported, the degree of nicotine dependence was also considered, as was the intervention provided i.e. counselling only, counselling plus nicotine replacement therapy etc.

All studies were also analysed according to the degree of detail provided about randomisation strategies and whether these were adequate or not. Grade A represents studies in which it is clear that randomisation was blinded, Grade B represents those in which it is thought that blinding took place but sufficient detail is not given to verify this, and those studies where randomisation was not blinded were graded C. The method of randomisation was also noted i.e. individual or cluster randomisation.

3.2.15 Limitations of included studies

In general, the quality of the observational studies included was high with all adequately describing participant eligibility criteria, study design and methodology (Appendix 16). Only three studies (Morgan et al. 2011; Prokhorov et al. 2002; Norman et al. 1990) failed to give sufficient details of the statistical methods used. Quality was found to be poorer with respect to reporting of sources of bias and possible limitations in the studies with 44.8% and 34.5% of papers respectively failing to fully acknowledge sources of bias and limitations.

The summary of the CONSORT statement checklist in Appendix 17 demonstrates that the randomised controlled trials included in this systematic literature review are of a good standard. Gansky et al. 2005 met the required standards regarding sequence generation, allocation concealment and implementation of the randomisation process but the others did not provide enough information to judge the quality of the process they undertook. Only one of the trials presented information of the trial registration details (Walsh et al. 2010), and none of the trials provided access to the study protocol. Due to the behavioural nature of the interventions used in these trials, the recipients and deliverers of the intervention could not be blinded.

The lack of biochemical verification of tobacco use status in all but one of the randomised controlled trials (Walsh et al. 2003) presents a potential source of bias as participants tend to report they have quit when this is not the case.

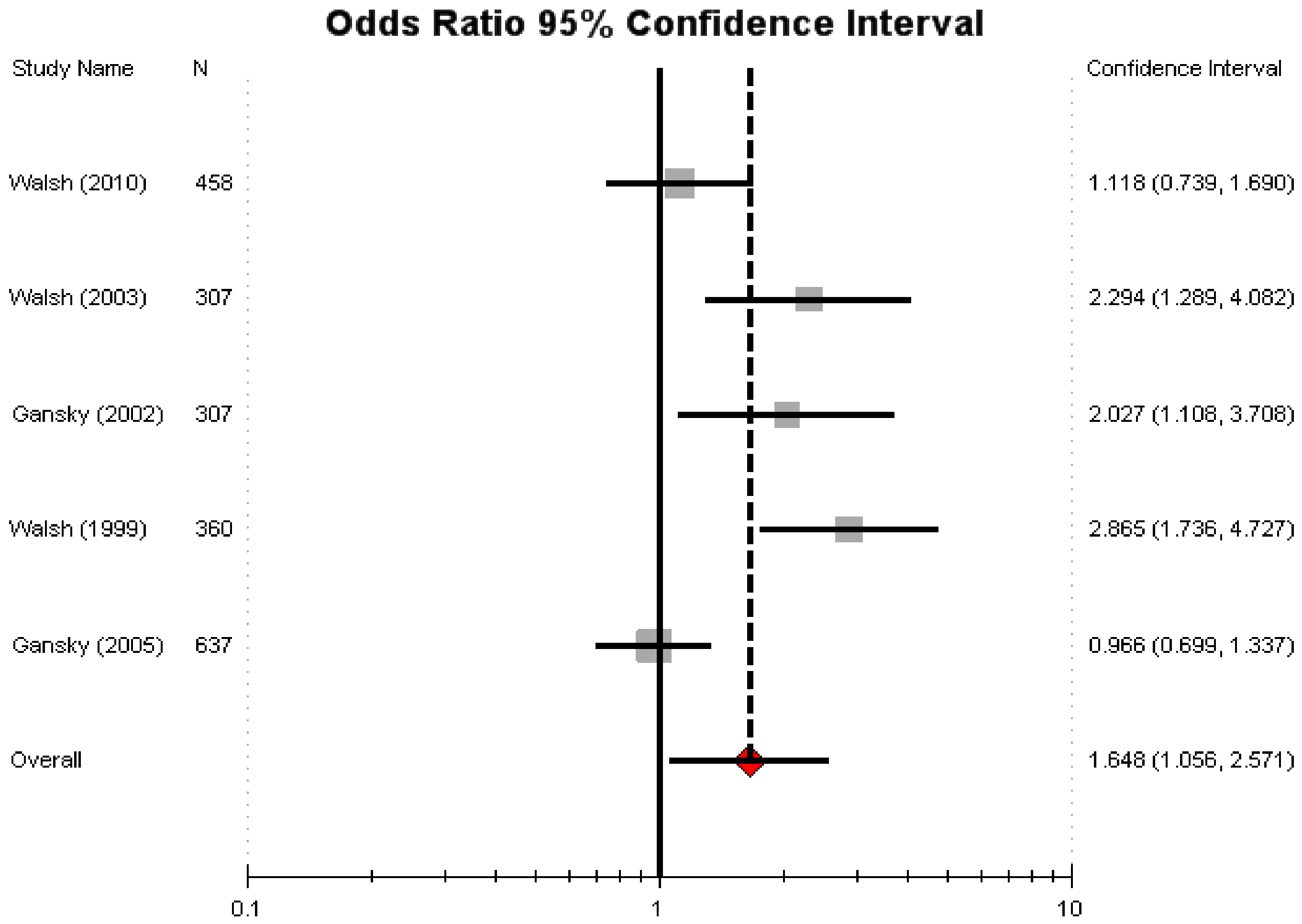
3.2.16 The meta-analysis

The results of Walsh et al. (2010) in Figure 3.2 show that the increase in abstinence in the intervention group over the control group did not reach significance as the odds ratio includes 1. These results include participants who smoked cigarettes as well as used smokeless tobacco. No intervention effect at all was found for combined smokeless and smoked tobacco users. However, when their results are analysed for smokeless tobacco users only, the results are highly significant in favour of the intervention ($p<0.02$).

The results of Walsh et al. (1999), Walsh et al. (2003) and Gansky et al. (2002) proved significantly in favour of the intervention group over the control group as the odds ratio does not include 1 and so the results would not have occurred by chance. Gansky et al. (2005) present results which are not significant as the odds ratios include 1 and so may have occurred by chance.

The meta-analysis shown in Figure 3.2 demonstrates an increase in the odds ratio of 1.6 for tobacco abstinence in intervention groups over control groups at 95% confidence intervals between 1.1 and 2.6 when the results of the five included randomised controlled trials are pooled. This indicates that the tobacco cessation interventions applied in the included studies had a small, but positive, effect in improving abstinence rates over the control groups.

Figure 3.2: Forest plot of trials included in the systematic review



3.2.17 Discussion

The evidence uncovered in this systematic literature review has been gathered from a wide variety of study designs, study participants and outcome measures. However, the data is of sufficient quality to allow inferences to be drawn with regard to the research question for the systematic literature review: does existing evidence suggest that smoking cessation activities which have included a dental component conducted in rural areas are necessary and effective?

The cross-sectional surveys of prevalence of tobacco use in rural areas identified in this literature review have shown that tobacco use varies with age, gender and geographical location. Studies in India have shown that even in children aged 11 – 15 years, 8% are regular tobacco users (Jayakrishnan et al. 2011), and this increases to 68% of males aged 15 – 19 years (Dongre et al. 2008). The importance of encouraging dental professionals to involve themselves in tobacco cessation activities in rural India cannot be overemphasised when females report using snuff to brush their teeth, and the main reason for initiating its use is to relieve toothache.

The gender differential is commonly found as many communities find it less acceptable for women to use tobacco than men. For example, Dongre et al. found only 12% of adolescent females using smokeless tobacco compared with 68% of males (Dongre et al. 2008). Similarly, in Sudan, smokeless tobacco use was 3% in females and 34% in males (Idris et al. 1998). Even in some more developed parts of the world the gender gap in tobacco use exists as shown by

Seki et al. in Japan in 2004 where very high prevalence rates of 68% of males and 49% of females were found.

A study of dental patients attending a dental school in Iran showed that there still exists a lack of knowledge of the effects of tobacco on oral health in some rural communities, as only 16% of this population identified smoking as a risk factor for oral cancer (Pakfetrat et al. 2010).

The link between tobacco use and oral disease has been demonstrated in both cross-sectional population studies and cohort trials in this literature review. In two cross-sectional studies the odds ratio for periodontal disease in smokers over non-smokers varied from 1.62 in a rural Thai population (Chatrchaiwiwatana et al. 2009) to 7.17 in rural Vietnam (Do et al. 2003). A cross-sectional study in rural India found that six percent of the population had suspicious oral lesions, with bidi and hookah smokers being six times more likely to present with them than non-smokers (Dangi et al. 2012).

In cohort studies in Sweden and India the role of tobacco use in oral disease was again confirmed, with Paulander et al. finding that smoking was the major risk factor for periodontal disease with an odds ratio of 3.2 (Paulander et al. 2004). Gupta et al. (1995) demonstrated the beneficial effects of tobacco cessation with the incidence of leukoplakia significantly dropping following cessation (Gupta et al. 1995).

Educational interventions ranged from testing of the appropriateness of available tobacco prevention and cessation literature (Weiner and Weiner 2011) to tobacco awareness raising and encouragement of tobacco cessation among schoolchildren (Jenkins and Geurink 2006), adolescents (Semer et al. 2005; DeMoss et al. 1997) and the population at large (Norman et al. 1990). These studies demonstrated that knowledge of the health impacts of smoking can be raised by educational interventions, and that recruitment to tobacco cessation programmes can be increased, especially when the intervention is tailored to the target population.

Walsh et al. showed that educational interventions targeting dental professionals can increase their knowledge, confidence and activity levels with respect to tobacco cessation activities with their patients (Walsh et al. 2012). This suggests that investment in educating dental professionals could yield benefits to public health by enhancing their willingness and capacity in tobacco cessation provision.

The potential for increased dental activity in tobacco cessation has been revealed in several studies examining current knowledge, attitudes and practices in tobacco cessation among dentists (Morgan et al. 2011; Squier et al. 2006; Brothwell and Armstrong 2004; Jennett et al. 1998). All of these studies demonstrated low levels of tobacco cessation provision in dental settings as well as lack of confidence among dental staff in providing these services. As well as lack of knowledge and confidence on their part, dental professionals also saw patient attitudes to dentists raising the issue of tobacco use as problematic as they are concerned patients would take offence or maybe even seek treatment elsewhere. The evidence in fact points to patients expecting to be asked and believing this to form part of the remit of the dental team (Campbell et al. 1999).

The literature also provides evidence that dental professionals have fallen behind other healthcare professionals when it comes to provision of tobacco use cessation (Zanis et al. 2008; Prokhorov et al. 2002; Block et al. 1999). In order to address this issue, it would seem prudent to introduce more training in the area of tobacco use cessation at both undergraduate and postgraduate levels for all dental care professionals.

The most striking feature of this systematic literature review is the scarcity of robust randomised controlled trials that have been undertaken in rural areas to assess the effectiveness of tobacco interventions. No papers were identified which showed periodontal outcomes following tobacco interventions, and all five of the included papers used outcome indicators relating to smokeless rather than smoked tobacco. As smokeless tobacco use in rural Scotland is negligible, this undermines the transferability of the results to the population being studied here. However, the interventions employed to encourage cessation of smokeless and smoked tobacco use are very similar, and so a degree of comparison can be justified. For example, the smokeless tobacco users in the five included studies underwent an oral examination and lesions in their own mouths were pointed out to them. All five included studies involved a counselling element provided by trained healthcare workers which focussed on identifying reasons the individual wished to quit, setting a quit date and developing coping strategies to deal with withdrawal symptoms and prevent relapse. These same components are advocated by the Scottish Government (NHS Health Scotland and ASH Scotland 2010) and the British Dental Association (Beaglehole and Watt 2004) among others.

The main omission found between recommendations for smoking cessation interventions and the smokeless tobacco interventions found in the included studies is the absence of provision of nicotine replacement therapy in all but one of them (Walsh et al. 1999). Provision of nicotine replacement therapy in combination with counselling has proved to give the most successful quit rates among smokers and it would seem likely that the same would apply to smokeless tobacco.

Whilst there is a good deal of homogeneity in the study participants and settings of the included randomised controlled trials, the differences in methodology complicate comparisons of results. For example, the study population in three of the studies (Gansky et al. 2005; Walsh et al. 2003; Gansky et al. 2002) included all baseball team members whether or not they were tobacco users whilst Walsh et al. (2010) and Walsh et al. (1999) reported only on smokeless tobacco users.
Different outcome measures are used to report results in the studies – either point prevalence or continuous abstinence. Four of the five randomised controlled trials used point prevalence, defined as no tobacco use in the previous 30 days, as their primary outcome measure (Gansky et al. 2005; Walsh et al. 2003; Gansky et al. 2002; Walsh et al. 1999). Walsh et al. (2010) used the recognised gold standard of tobacco abstinence outcome measures i.e. continuous abstinence from tobacco use throughout the twelve month study period.

The lack of clarity regarding the randomisation process in most of these studies is disappointing and introduces an element of potential bias to the results.

Walsh et al. (2003) used the “bogus pipeline” methodology to enhance the validity of their results. This involved collecting saliva samples from all participants, and although only a proportion of them were analysed, participants had no way of knowing if their samples would be among those. The researchers found that 8% of those claiming to have quit tobacco use showed salivary cotinine levels inconsistent with non-tobacco users and so the results of the other studies included here are likely to overestimate the impact of the intervention delivered.

Three of the randomised controlled trials included in this review demonstrated the effectiveness of the tobacco cessation intervention used over usual care with odds ratios of 2.03, 2.29 and 2.87 respectively (Gansky et al. 2002; Walsh et al. 2003; Walsh et al. 1999). Walsh et al. (2010) and Gansky et al. (2005) showed no significant difference in tobacco cessation rates between the intervention and control groups. However, the combined results of the trials as demonstrated in the meta-analysis shows that evidence to date points to an overall positive effect on tobacco use cessation as a result of the interventions described.

The conclusions drawn from this systematic literature review and meta-analysis that there are significant effects resulting from tobacco cessation interventions is supported by the Cochrane Reviews conducted by Carr and Ebbert in 2006 and 2012.

3.2.18 Conclusions

The results of this systematic literature review would suggest that tobacco use cessation is indeed necessary in rural populations as demonstrated by its prevalence which ranged from 8 – 68% in the papers included.

As demonstrated in the narrative literature review, tobacco use is a major risk factor for both periodontal disease and oral malignancy, and the data from various cross-sectional and cohort trials included in this literature review have confirmed this in rural populations. This verifies the validity of dental professionals using every opportunity to support patients in quitting tobacco use.

A lack of knowledge of the impact of tobacco use on oral health among rural populations has also been shown, but the papers included in the review verify that educational interventions can enhance knowledge and increase engagement with tobacco cessation support services. It is therefore imperative that educational interventions, specifically tailored to the target population, continue to be provided.

Dental professionals do not provide tobacco use cessation interventions as frequently as other healthcare professionals and do not feel adequately prepared to do so. This must be addressed at undergraduate and postgraduate levels in order that the opportunities dental professionals have to promote tobacco cessation are not missed. The evidence suggests that patients are far less sensitive about being questioned and offered support regarding their tobacco use than dental professionals imagine and this message should be widely disseminated among dental staff.

The research question for this systematic literature review examined the evidence-base regarding the effectiveness of tobacco cessation interventions undertaken in remote-rural areas. To answer the research question rigorously conducted randomised controlled trials were included in the review. There were few RCTs that assessed the effectiveness of smoking cessation programmes and those that did were RCTs concerning smokeless tobacco rather than smoked tobacco. The RCTs included male, athletic participants and the results may not be considered transferable to the whole population in remote-rural areas. Therefore it is suggested that more research is required to demonstrate the effectiveness of smoking cessation interventions, and which elements ensure participant success. The potential benefits of smoking cessation interventions in remote-rural districts are required and so further research is justified.

3.3 Modelling a smoking cessation intervention for primary dental care in remote-rural Scotland

3.3.0 Introduction

This section explores the prevalence and knowledge of the effects of smoking, attitudes to smoking, and to smoking cessation in dental settings, and the oral health-related quality of life amongst primary dental care patients in this remote and rural area as well as conducting a basic periodontal clinical examination. In any instance where details of this study reflect those in the original randomised controlled trial, a link will be made to the appropriate section.

The aim was to model a smoking cessation intervention for primary dental care in remote-rural Scotland. The specific objectives were to:

1. determine the prevalence and risk factors for chronic periodontitis, and its impact on oral health-related quality of life in a population of registered primary care dental patients in a rural area of Scotland.
2. model a smoking cessation intervention based on smoking status, periodontal health status and oral health-related quality of life collected in a sample of adults attending a general dental practice in a remote and rural area.
3. recommend the characteristics of a feasibility trial for a smoking cessation intervention for primary dental care in remote-rural Scotland

3.3.1 Method for the smoking and periodontal health prevalence and attitudes study

The survey was conducted in two remote-rural salaried primary dental care practices located in Lochgilphead and Dunoon (Figure 1.1) in Argyll and Bute Community Health Partnership. Data were collected relating to known factors impacting on periodontal treatment need, and detailed information of smoking-related knowledge, attitudes and behaviours amongst those who smoked was also gathered. A basic periodontal examination was also undertaken.

<u>Sample population</u>

A convenience sample was drawn from regularly attending adult patients aged eighteen years and over who regularly attended the dental practices in Lochgilphead and Dunoon. Regular dental attenders were defined as registered patients who had attended the dental practice on a yearly basis in the previous two years.

All patients were invited to participate regardless of their smoking status and oral health status. The Adults with Incapacity (Scotland) Act 2000 decrees that “no research shall be carried out on any adult who is incapable in relation to a decision about participation.” An exception is made where the research is investigating the cause of the adult’s incapacity, but as this does not apply to this study no potential participants lacking capacity to provide informed consent were included. No exclusion criteria other than age and an inability to provide informed consent were applied.

Sample size

A sample size of 136 was required to provide a representative sample of the 4,500 registered adult patients with a margin of error of 5%, confidence levels of 95%, and 90% response rate. The Raosoft Sample Size Calculator software was used to produce the sample size.

A convenience sample of patients attending for routine dental care on the days the researcher was available was included in the study. Patients attending for dental care were approached personally by the researcher, who explained the purpose of the survey, and invited them to complete a questionnaire and allow a basic periodontal examination.

The questionnaire

The questionnaire was the same as that described in Chapter 2 with additional questions relating to the role of dental health professionals in smoking cessation programmes (Appendix 2).

The additional questions included the assessment of participants' attitudes to dental professionals providing smoking cessation. Four statements asked participants to what extent they agreed that:

[1] dentists should ask about smoking status,

[2] offer advice about stopping smoking,

[3] provide stop smoking counselling and

[4] provide nicotine replacement therapies.

A Likert-scale offering five responses ranging from “definitely agree” (scoring 5) to “definitely disagree” (scoring 1) was used. The statements used were those included by Campbell et al. (1999) and included an additional question regarding dentists offering nicotine replacement therapy.

Participants were also asked to report if they were a current smoker, ex-smoker or had never smoked. Ex-smokers were asked to record how much time had elapsed since they had quit smoking tobacco. Only smokers were requested to respond to the remaining questions which related to their smoking attitudes and behaviours. This included providing information about which tobacco products they used, their level of nicotine dependence, lifetime exposure to tobacco, attitudes to their smoking habit and any recent attempts to cut down or quit smoking as described in Chapter 2.

Finally all participants were asked whether their dentist had ever asked about their smoking status, offered them advice about quitting smoking or offered to refer them to stop smoking services (Brothwell and Armstrong 2004).

Clinical Examination

[1] The Basic Periodontal Examination (BPE) as developed by the British Society of Periodontology and updated in October 2011 provides a standardised system of codes for scoring periodontal health as shown in Table 2.1 on page 31.

As specified in the BPE guidance, World Health Organisation BPE probes with a 0.5mm ball-end and a black band from 3.5 to 5.5mm were used to assess periodontal health. A probing force of 20-25 grams was applied to determine periodontal pocket depths. For the purposes of recording the BPE, the mouth is divided into sextants and the highest score found by walking the probe round the sulcus of each tooth is recorded for each sextant.

A calibration exercise was undertaken to test the robustness of the data collected by KE against that of an expert examiner (AFH). This exercise involved the examination of ten volunteers by both KE and the consultant AFH as gold standard. A period of fifteen minutes between each examination of each patient allowed any bleeding resulting from probing to cease.

In order to maximise the value of BPE measurements as an independent variable in the analysis of this dataset, the scores were subdivided to signify the degree of complexity of the treatment need they represent. The categorisation of the complexity of treatment need follows the Periodontal Treatment Assessment advocated in the British Society of Periodontology “Referral Policy and Parameters of Care” as updated in 2011. All participants were categorised as follows:

- Complexity 1 = BPE score of 0 – 3 in any sextant
- Complexity 2 = BPE score of 4 in any one sextant
- Complexity 3 = BPE score of 4 in more than one sextant, or a BPE score of 4 in one sextant and a concurrent medical factor affecting the periodontal tissues e.g. diabetes, complicating root morphologies, or non-response to previous optimal treatment

The complexity rating of a participant could be increased by one level only if they presented with one or more modifying factor such as significant immunosuppression, furcation involvement or smoking ten or more cigarettes per day.

These three groups, as well as representing increasing complexity of treatment needs, also demonstrate increasing time, material and financial resource requirements, and those in Complexity 3 group may require referral to secondary care thus substantially increasing treatment costs.

<u>Ethical considerations</u>

Ethical approval was obtained from the East of Scotland Research Ethics Service – REC reference number 10/S0501/37. NHS Highland Research & Development Department also approved the project – R&D reference number 684.

As in the randomised controlled trial, any potential participant who did not demonstrate capacity to provide informed consent was excluded from the study (Adults with Incapacity (Scotland) Act 2000 s5).

<u>Administration of questionnaires and clinical examination</u>

During the period from March to October 2012, patients attending the dental practice in Lochgilphead and Dunoon for routine appointments were approached by the researcher in the dental waiting area. A brief explanation of the research being conducted was provided verbally and the patient asked if they would be willing to complete a self-administered questionnaire and undergo a basic periodontal examination. The self-administered questionnaire was completed in a private area of the waiting room away from other waiting patients. The periodontal examination was conducted in the dental surgery. Any patient indicating that they wished to complete the questionnaire but required assistance, had the questions read to them in the dental surgery to ensure confidentiality.

The basic periodontal examination was undertaken in the dental chair using standard high-quality lighting and WHO BPE probes, and in accordance with the guidance provided by the British Society of Periodontology.

All questionnaires and other paperwork associated with the survey was collected by KE and stored in a locked filing cabinet in an office which was kept locked when not in use.

Data Analysis

The categorisation of variables to facilitate data analysis was conducted as described in Chapter 2, Section 2.3.7. The BPE data replaced the bleeding on probing, plaque index, pocket depth and attachment loss data and was categorised according to the parameters of care devised by the British Society of Periodontology resulting in a score of 0 – 4 for each sextant.

Statistical Analysis

The statistical analysis of all data in this survey used the SPSS V16.0. The questionnaire data were collated and coded, then entered onto the SPSS database. Statistical analysis was conducted using frequency distributions, and continuous data analysed using t-tests and Analysis of Variance (ANOVA), with statistical differences between groups being determined by post hoc Scheffe tests. Categorical data was analysed using chi-squared tests. Only results with a p-value of 0.05 or less were regarded as significant.

The scores for the twelve smokers' attitudinal items in the survey questionnaire were subjected to a principle components factor analysis with varimax rotation resulting in clustering of the attitudes to form a consistent scale. Cronbach's alpha was used to test the internal reliability of the scales.

The strength of the relationships between age, smoking status, oral health-related quality of life and periodontal status were analysed using the electronic software package SPSS Amos, a structural equation modelling (SEM) tool. This statistical tool was chosen as it allows the covariance between observed variables to produce a small number of latent variables, in this case to predict the factors relevant to smokers considering quitting.

3.3.2 Results

3.3.2.1 Sample

Three hundred and ninety nine general dental practice patients took part in the study. A total of 412 patients were approached and asked to complete a questionnaire, of whom 13 refused. Reasons for non-participation included lack of time (6), not wishing to participate in a research project (4) and three people gave no reason. This resulted in a response rate of 96.8%. One returned questionnaire was found to have no data recorded except age, leaving a total of 398 valid questionnaires for analysis and a valid response rate of 96.6%. Seventy six percent of the participants were from Lochgilphead and the remainder from Dunoon.

3.3.2.2 Demographic data

- Age profile of sample

The age range of participants was from 18 to 87 years. The median age was 49.50 years and the mean age was 49.18 years (95%CI: 47.68, 50.68). The mean age of the sample in Dunoon was 47.26 years (95%CI: 45.72, 48.80), and in Lochgilphead 49.80 years (95%CI: 48.92, 50.77). There was no significant difference in mean age of participants in each location (t=1.44: p=0.86).

The median age of the participants was 49.5 years. The sample was divided into two age groups – younger being forty-nine years old or younger, and older being fifty years or older. This meant that 50.3% of the sample was classified as younger and 49.7% classified as older.

- Gender profile of sample

Males accounted for 39% and females for 61% of the sample. The mean age of 52.3 years (95%CI: 51.22, 53.42) for the male participants was significantly higher than the mean of 47.3 years (95%CI: 46.17, 48.19) in females (t=3.33: p=0.02).

Table 3.4: Demographic profile by age, location and gender

		Mean age in years (95% CI)	F[df]	P
Lochgilphead	Male (n=109)	52.17 (49.36, 54.99)	3.49 [3, 394]	0.06
	Female (n= 192)	48.46 (46.34, 50.58)		
Dunoon	Male (n=46)	52.68 (48.35, 57.00)		
	Female (n=51)	42.37 (38.26, 46.48)		

The grouping variable “locality by gender” did not explain differences in the mean age of the participants. Although the women in both Lochgilphead and Dunoon were younger than the men, this difference did not reach statistical significance (Table 3.4).

- Ethnicity of sample

Three hundred and eighty-nine (92.7%) of the population were Caucasian, the remainder of the participants were African/Caribbean, Asian and mixed race.

- Occupational profile of sample

Respondents were asked to record their occupation which was then assigned to four levels of occupation according to the Standard Occupational Classification (Office of National Statistics, 2010). A total of 333 participants stated their occupation with only 66 (16.5%) failing to do so. This tended to be amongst the older age group who frequently recorded that they were retired. Table 3.5 shows the range of occupations across this population of respondents.

Table 3.5: Occupational group by frequency

Occupational group	Code for occupational group	Frequency	%
Skills achieved via compulsory school education	1	98	29.4
Skills requiring workplace training	2	88	26.4
Skills requiring sub degree level qualification	3	95	28.5
Skills requiring degree level qualification	4	52	15.6

There was a significant association between age and reported occupation. No other significant associations were demonstrated (Table 3.6).

Table 3.6: Occupational group by age group, location and gender

	Occupational group				X^2 [df]	P
	1 n (%)	2 n (%)	3 n (%)	4 n (%)		
Age group:						
Younger (49 years or under)	55 (31.2)	55 (31.2)	47 (26.7)	19 (10.8)	9.70 [3]	0.02
Older (50 years or over)	43 (27.4)	33 (21.0)	48 (30.6)	33 (21.0)		
Location:						
Lochgilphead	73 (29.1)	61 (24.3)	72 (28.7)	45 (17.9)	5.28 [3]	0.15
Dunoon	25 (30.5)	27 (32.9)	23 (28.0)	7 (8.5)		
Gender:						
Male	33 (26.2)	33 (26.2)	36 (28.6)	24 (19.0)	2.26 [3]	0.52
Female	65 (31.4)	55 (26.6)	59 (28.5)	28 (13.5)		

3.3.2.3 Reported medical status

One hundred and forty-three (35.8%) of the participants stated they were receiving treatment from their doctor and 216 (54.1%) reported they were currently taking prescribed medication.

The reported frequency of each medical condition in descending order was as follows: allergies (22.3%), high blood pressure (18.3), lung diseases (10%), blood disorders (9.8%), angina (4.5%), diabetes (4.3%), heart attack (3%), infectious diseases (1.3%) and epilepsy (0.8%).

- Reported medical condition by age group

Significantly larger proportions of older compared with younger participants reported receiving treatment, taking medication and having angina, hypertension and heart attacks. All eight pregnant women were in the younger age group. No significance was found in the proportion of people in younger and older age groups with respect to infectious diseases, lung diseases, epilepsy, diabetes, blood disorders and allergies (Table 3.7).

- Reported medical condition by gender

Significant gender differences were encountered with greater proportions of males reporting angina, hypertension, heart attack and diabetes, and a higher proportion of females reporting blood disorders, allergies and of course, pregnancy (Table 3.7).

- Reported medical condition by participant occupation

No significant associations were found in the proportion of participants in each of the four occupational groups with respect to their reported medical status except for the proportion of those reporting they were "receiving treatment" which reached significance at the 5% level (Table 3.7).

- Reported medical condition by locality

The proportion of participants residing in Dunoon was significantly higher than the proportion of those living in Lochgilphead with respect to reporting they experienced heart attack and blood disorders (Table 3.7).

Table 3.7: Reported medical condition by age group, gender, occupational group and location

Reported medical condition	Age group		Gender		Occupational group		Location	
	X^2 [df]	P	X^2 [df]	P	X^2 [df]	P	X^2 [df]	P
Receiving treatment	8.39 [1]	0.004	0.85 [1]	0.36	8.06 [3]	0.05	2.50 [2]	0.29
Taking medication	9.78 [1]	0.002	1.12 [1]	0.29	6.15 [3]	0.11	3.20 [2]	0.20
Angina	11.55 [1]	0.001	6.09 [1]	0.01	6.15 [3]	0.11	2.77 [2]	0.25
Hypertension	7.66 [1]	0.006	6.46 [1]	0.01	2.38 [3]	0.50	1.10 [2]	0.58
Heart attack	8.70 [1]	0.003	4.00 [1]	0.05	1.02 [3]	0.80	7.59 [2]	0.02
Infectious diseases	0.21 [1]	0.65	0.01 [1]	0.96	1.47 [3]	0.69	3.49 [1]	0.06
Lung diseases	0.94 [1]	0.33	0.04 [1]	0.84	4.15 [3]	0.25	3.02 [2]	0.22
Epilepsy	0.33 [1]	0.57	0.04 [1]	0.84	2.41 [3]	0.49	0.13 [1]	0.72
Diabetes	3.09 [1]	0.08	4.96 [1]	0.03	4.79 [3]	0.19	3.02 [2]	0.22
Blood disorder	2.40 [1]	0.12	6.18 [1]	0.01	2.54 [3]	0.47	16.99[1]	<0.001
Allergies	0.004 [1]	0.95	6.92 [1]	0.009	2.12 [3]	0.55	0.90 [2]	0.64
Pregnant	8.08 [1]	0.004	5.21 [2]	0.02	3.99 [3]	0.26	0.00 [1]	0.97

A significant association was demonstrated between reported smoking status and reported medical condition for receiving treatment (p=0.02), blood pressure problems (p=0.01), heart attack (p=0.01) and infectious diseases ($p<0.01$) (Appendix 18, Table A1).

3.3.2.4 Reported smoking status

Participants were asked to categorise themselves as current smokers, ex-smokers and never smokers and the reported frequency of each category is recorded in Table 3.8. Twenty three percent stated they were current smokers.

Table 3.8: Frequency of reported smoking status

Smoking status	Number	Percent
Never smoker	185	46.6
Ex-smoker	119	30.0
Current smoker	93	23.4

Table 3.9 shows the demographic profile of the study population by smoking status. There was a significant association between reported smoking status with age, occupational group and locality. The proportion of current smokers based in Dunoon was twice that of Lochgilphead; the proportion of current smokers was double in the younger group than in the older; the proportion of people in occupations requiring lower educational qualifications who reported they were current smokers was higher than in other occupational groups.

Table 3.9: Reported smoking status by demographic profile

		Reported smoking status				
		Never smoker n (%)	Ex-smoker n (%)	Current smoker n (%)	X^2 [df]	P
Age group	Younger (49 years or under)	95 (47.7)	41 (20.6)	63 (31.7)	23.35 [2]	<0.001
	Older (50 years or over)	90 (45.5)	78 (39.4)	30 (15.2)		
Gender	Male	66 (42.6)	52 (33.5)	37 (23.9)	1.99 [2]	0.37
	Female	119 (49.2)	67 (27.7)	56 (23.1)		
Occupational group	1	31 (31.6)	34 (34.7)	33 (33.7)	29.32 [6]	<0.001
	2	43 (49.4)	18 (20.7)	26 (29.9)		
	3	60 (63.2)	26 (27.4)	9 (9.5)		
	4	21 (40.4)	20 (38.5)	11 (21.2)		
Location	Lochgilphead	152 (50.7)	91 (30.3)	57 (19.0)	14.68 [2]	0.001
	Dunoon	33 (34.0)	28 (28.9)	36 (38.7)		

3.3.2.5 Knowledge of impacts of smoking on health

Participants in this study completed a table listing a range of medical conditions and were asked to record whether they considered the conditions to be related to smoking or not (Table 3.10). The average frequency of correct responses over all 12 physical conditions listed was 54.6%. The frequency of correct answers ranged from 91.5% of respondents correctly asserting that smoking was related to lung cancer to only 10.8% correctly recording that smoking tobacco was implicated in dementia (Table 3.10).

Table 3.10: Knowledge of smoking-related health conditions

Smoking-related health conditions	Correct response (number)	Correct response (percent)
1. Arthritis	86	21.6
2. Heart disease	354	88.9
3. Gum disease	335	84.2
4. Skin disease	116	29.1
5. Broken arm	339	85.2
6. High blood pressure	297	74.6
7. Mouth cancer	363	91.2
8. Lung cancer	364	91.5
9. Toothache	119	29.9
10. Dementia	43	10.8
11. Bronchitis	322	80.9
12. Liver disease	266	66.8

- Smoking-related health knowledge by age group

With respect to knowledge of the role of smoking in disease, age proved a factor in only three categories with a significantly lower proportion of the younger age group giving a correct answer to whether smoking was related to arthritis. Significantly higher proportions of younger compared to older age groups correctly stated that smoking was related to gum disease but not to fractures (broken arm) (Table 3.11).

- Smoking-related health knowledge by gender

Significantly higher proportions of female compared with male participants correctly stated that smoking was not related to toothache. No other significant differences were noted (Table 3.11).

- Smoking-related health knowledge by occupational group

A significant association was demonstrated between smoking-related health knowledge and occupational status for the smoking related conditions of arthritis, heart disease and lung cancer (Table 3.11).

- Smoking-related health knowledge by location

A larger proportion of Lochgilphead participants answered correctly that arthritis was a smoking-related than participants in Dunoon. No other statistically significant differences were found in smoking-related health knowledge between the two localities (Table 3.11).

- Smoking-related health knowledge by reported smoking status

There was a significant association in that higher proportions of current smokers stated that there was no link between smoking and the diseases listed, while higher proportions of ex-smokers and never smokers tended to assume a relationship between smoking and all the conditions listed. This resulted in the group of smokers faring disproportionately well in questions with a negative response and vice versa for ex- and never smokers. Significant associations were therefore found in relation to skin disease and broken arm with significantly larger proportions of current smokers than non-smokers giving correct answers, whereas significantly smaller proportions of current smokers gave correct responses with relation to mouth cancer, lung cancer and liver disease. Significantly lower proportions of smokers correctly stated that arthritis could be smoking-related than ex-smokers or never smokers (Table 3.12).

Table 3.11: Smoking-related health knowledge by age group, gender, occupational group and location

Smoking-related health conditions	Age group		Gender		Occupation		Location	
	X^2 [df]	P	X^2 [df]	P	X^2 [df]	P	X^2 [df]	P
Arthritis	13.74 [1]	<0.001	0.02 [1]	0.90	14.32 [3]	<0.001	9.67 [1]	<0.001
Heart disease	0.99 [1]	0.32	1.60 [1]	0.21	10.23 [3]	0.02	1.03 [1]	0.31
Gum disease	12.09 [1]	0.01	0.02 [1]	0.88	1.27 [3]	0.74	1.15 [1]	0.28
Skin disease	0.14 [1]	0.71	0.90 [1]	0.35	3.63 [3]	0.31	3.49 [1]	0.06
Broken arm	9.03 [1]	<0.001	0.00 [1]	0.99	3.74 [3]	0.29	0.21 [1]	0.65
High blood pressure	0.03 [1]	0.86	0.10 [1]	0.75	0.14 [3]	0.99	0.94[1]	0.33
Mouth cancer	0.32 [1]	0.57	0.25 [1]	0.62	6.04 [3]	0.11	0.04 [1]	0.85
Lung cancer	0.15 [1]	0.70	1.91 [1]	0.17	18.36 [3]	<0.001	2.41 [1]	0.12
Toothache	1.30 [1]	0.26	4.40 [1]	0.04	0.86 [3]	0.83	0.07 [1]	0.80
Dementia	3.28 [1]	0.07	0.33 [1]	0.56	3.38 [3]	0.34	0.31 [1]	0.58
Bronchitis	0.94 [1]	0.33	1.20 [1]	0.16	5.74 [3]	0.13	0.21 [1]	0.65
Liver disease	2.02 [1]	0.16	0.01 [1]	0.76	1.01 [3]	0.80	0.49 [1]	0.48

Table 3.12: Smoking-related health knowledge by reported smoking status

Smoking-related health condition	Reported smoking status			X^2 [df]	P
	Never smoker n (%)	Ex-smoker n (%)	Current smoker n (%)		
Arthritis	43 (23.2%)	31 (26.1%)	12 (12.9%)	5.83 [2]	0.05
Heart disease	163 (88.1%)	110 (92.4%)	80 (86.0%)	2.41 [2]	0.30
Gum disease	154 (83.2%)	99 (83.2%)	81 (87.1%)	0.80 [2]	0.67
Skin disease	45 (24.3%)	32 (26.9%)	39 (41.9%)	9.73 [2]	<0.001
Broken arm	149 (80.5%)	102 (85.7%)	87 (93.5%)	8.32 [2]	0.02
High blood pressure	137 (74.1%)	95 (79.8%)	64 (68.8%)	3.39 [2]	0.18
Mouth cancer	170 (91.9%)	113 (95.0%)	79 (84.9%)	6.73 [2]	0.04
Lung cancer	172 (93.0%)	113 (95.0%)	78 (83.9%)	9.24 [2]	0.01
Toothache	48 (25.9%)	42 (35.3%)	29 (31.2%)	3.10 [2]	0.21
Dementia	24 (13.0%)	10 (8.4%)	8 (8.6%)	2.10 [2]	0.35
Bronchitis	145 (78.4%)	99 (83.2%)	77 (82.2%)	1.38 [2]	0.50
Liver disease	137 (74.1%)	77 (64.7%)	52 (55.9%)	9.62 [2]	<0.001

3.3.2.6 Smoking–related attitudes

Smokers were asked to grade their responses to a series of statements which assessed their attitudes to their own smoking habits using a five-point Likert – scale ranging from “not at all” to “very much” scoring from 1 through to 5. The five Likert responses were condensed into three groups to facilitate analysis and reporting of the data as follows: “not at all concerned”, “moderately concerned” and “highly concerned” (Table 3.13).

Table 3.13: Smoking-related attitudes

	Smoking-related attitude	Category by degree of concern		
		Not at all n (%)	Moderately n (%)	Highly n (%)
1	Concerned about effects on my health	7 (7.6%)	32 (34.8%)	53 (57.6%)
2	Concerned about effects on health of others	9 (9.8%)	33 (35.9%)	50 (54.3%)
3	People close want me to quit	16 (17.4%)	18 (19.6%)	58 (63.0%)
4	I am confident with personal problems	5 (5.4%)	23 (25.0%)	64 (69.6%)
5	Things have gone my way recently	18 (19.6%)	32 (34.8%)	42 (45.7%)
6	I want to cut down my smoking	7 (7.6%)	30 (32.6%)	55 (59.8%)
7	I want to quit smoking	11 (12.0%)	26 (28.3%)	55 (59.8%)
8	I intend to quit smoking	14 (15.2%)	24 (26.1%)	54 (58.7%)
9	Confident could refrain when angry	31 (33.7%)	39 (42.4%)	22 (23.9%)
10	Confident could refrain when under pressure	38 (41.3%)	32 (34.8%)	22 (23.9%)
11	Confident I could cut down	9 (9.8%)	33 (35.9%)	50 (54.3%)
12	Confident I could quit altogether	16 (17.4%)	34 (37.0%)	42 (45.7%)

Table 3.13 shows that current smokers were very concerned about the effect that smoking had on their own and others' health. Sixty three percent reported that those close to them wanted them to quit which should assist in the success of any quit attempts, as should the high degree of confidence in dealing with personal problems reported.

Almost 60% of participants reported they very much wanted to cut down or quit smoking, but only one quarter of respondents felt confident they could refrain from smoking when angry or under pressure. Over half of respondents felt confident they could cut down on their smoking, and 45% felt they could stop all together.

When the smoking-related attitudes were analysed by age group, gender, occupational group and location, participants of Dunoon had significantly lower mean scores for the attitude ‘Things have gone my way recently’ (Mean=2.53, SD=1.44) compared with participants from Lochgilphead (Mean=3.46, SD=1.28) (t=3.26:P=0.02).

Principal component factor analysis

All scores for the 12 attitudinal items were subjected to a principal components factor analysis with varimax rotation which is a method to cluster items together to form a consistent scale. Two scales were identified which explained 59.7% of the variance. Scale 1 was composed of items 1, 2, 3, 6, 7 and 8, and had an Eigen value of 4.66. It explained 38.8% of the variance. Scale 2 had an Eigen value of 2.51 and comprised items 4, 5, 9, 10, 11 and 12, and this scale explained a further 20.9% of the variance (Table 3.14).

The items in each of the two scales described different aspects of the smoking-related attitudes. Scale 1 was therefore conceptualised as ‘willingness to quit smoking’ and Scale 2 as ‘confidence to quit smoking’.

On analysis of the two attitudinal scales by gender, age group, occupational status and location, no significant differences were found. Smoking-related health knowledge did not vary significantly by attitudinal scale. Significant differences were found when analysing the ‘confidence to quit’ scale by lifetime exposure to tobacco with the mean scores for those in the high exposure group being significantly lower than for the low and moderate exposure groups (F=8.18: df=2,89: p=0.001). Similar results were found indicating a significant reduction in confidence to quit with increasing levels of nicotine dependence ($F=8.19$: $df=2,89$: $p=0.001$) (Table 3.15). No significant differences in means were found between exposure to tobacco and nicotine dependence and the 'willingness to quit smoking' scale.

Table 3.14: Smoking attitudes scales and items

Item		Cronbach's alpha	Factor loading	Mean (95% CI)
	Scale 1: willingness to quit smoking	**0.89**		**21.21 (19.80, 22.62)**
1	Concerned about effects on my health		0.85	3.44 (3.16,3.73)
2	Concerned about effects on health of others		0.70	3.45 (3.16, 3.75)
3	People close want me to quit		0.49	3.59 (3.28, 3.89)
6	I want to cut down my smoking		0.89	3.63 (3.36, 3.90)
7	I want to quit smoking		0.92	3.58 (3.28, 3.87)
8	I intend to quit smoking		0.89	3.51 (3.21, 3.81)
	Scale 2: confidence to quit smoking	**0.79**		**18.10 (16.91, 19.28)**
4	I am confident with personal problems		0.47	3.80 (3.55, 4.06)
5	Things have gone my way recently		0.54	3.10 (2.80, 3.39)
9	Confident could refrain when angry		0.81	2.49 (2.20, 2.78)
10	Confident could refrain when under pressure		0.87	2.32 (2.03, 2.60)
11	Confident I could cut down		0.72	3.33 (3.05, 3.60)
12	Confident I could quit altogether		0.69	3.07 (2.78, 3.35)

Table 3.15: Confidence to quit by pack years and nicotine dependence

Confidence to quit scale		Mean	Standard deviation	F [df]	P
Life pack years	Low	19.60[2]	4.97	8.18 [2, 89]	0.001
	Moderate	18.80[2]	5.73		
	High	13.90[1]	5.35		
Nicotine dependence	Low	19.98[2]	5.29	8.19 [2, 89]	0.001
	Moderate	16.50[1,2]	5.46		
	High	13.13[1]	4.67		

*The suffixes show the significant differences in confidence to quit which existed between categories of life pack years and nicotine dependence

With respect to quit attempts in the previous two months, there was a significant difference in the mean scores for the 'willingness to quit' scale between those who had not tried to cut down (t=2.06, p=0.04), tried to stop (t=4.01, p<0.001) or quit for at least 24 hours (t=2.39, p=0.02), and those who had (Table 3.16). A significant difference in mean scores for the 'confidence to quit' scale was found only for those who had and those who had not cut down (t=2.22, p=0.03) (Table 3.16).

Table 3.16: Willingness to quit scale and confidence to quit scale by quit attempts

Willingness to quit scale					
		Mean	Standard deviation	t	P
Cut down	No (n=56)	20.09	7.09	2.06	0.04
	Yes (n=36)	22.94	6.06		
Tried to quit	No (n=70)	19.91	6.82	4.01	<0.001
	Yes (n=22)	25.32	5.03		
Stopped for >24 hours	No (n=66)	20.19	7.38	2.39	0.02
	Yes (n=30)	23.30	4.93		
Confidence to quit scale					
		Mean	Standard deviation	t	P
Cut down	No (n=56)	17.07	5.69	2.22	0.03
	Yes (n=36)	19.69	5.44		
Tried to quit	No (n=70)	17.51	5.77	1.86	0.07
	Yes (n=22)	19.95	5.24		
Stopped for >24 hours	No (n=66)	17.40	5.90	1.78	0.08
	Yes (n=30)	19.53	5.10		

Participants who did not plan to stop and those who did not plan to stop within 6 months had significantly lower mean scores for ‘confidence to quit’ compared with participants who had set a quit date within the next 30 days (F=5.12, p=0.003) scales (Table 3.17).

Table 3.17: Willingness to quit scale and confidence to quit scale by readiness to quit

Willingness to quit scale					
	Number of participants	Mean	Standard deviation	F [df]	P
Don’t plan to stop	18	12.06^{1}	4.40	29.33 [3, 88]	<0.001
Not in next 6 months	16	20.38^{2}	6.35		
Seriously plan to stop in next 6 months	51	$23.88^{2,3}$	4.70		
Quit date set in next 30 days	7	27.14^{3}	3.02		
Confidence to quit scale					
	Number of participants	Mean	Standard deviation	F [df]	P
Don’t plan to stop	18	15.33^{1}	5.74	5.12 [3, 88]	0.003
Not in next 6 months	16	15.75^{1}	5.43		
Seriously plan to stop in next 6 months	51	$19.16^{1,2}$	5.45		
Quit date set in next 30 days	7	22.86^{2}	2.54		

*The suffixes show the significant differences in willingness to quit which existed between stages of readiness to quit

The grouping variable complexity of periodontal treatment need did not explain differences in mean scores for ‘willingness to quit’ or ‘confidence to quit’ (Table 3.18).

Table 3.18: Willingness to quit scale and confidence to quit scale by complexity of periodontal treatment need

Willingness to quit scale					
	Number of participants	Mean	Standard deviation	F [df]	P
Complexity 1	41	21.51	5.92	0.80 [2,89]	0.92
Complexity 2	40	20.90	7.47		
Complexity 3	11	21.81	7.99		
Confidence to quit scale					
	Number of participants	Mean	Standard deviation	F [df]	P
Complexity 1	41	18.80	6.18	0.57 [2,89]	0.57
Complexity 2	40	17.76	5.41		
Complexity 3	11	17.36	5.16		

When examining the association between 'willingness to quit' with oral health-related quality of life, significant positive correlations were found with experiencing pain (r_p=0.39, p<0.001), experiencing discomfort when eating (r_p =0.30, p=0.004), having to interrupt meals because of dental problems (r_p =0.22, p=0.04) and finding it difficult to relax (r_p =0.23, p=0.03). The only significant association between "confidence to quit" scale and oral health-related quality of life was a negative correlation with feeling embarrassed by one's teeth (r_p =0.21, p=0.05).

A significantly positive correlation was found between mean scores for 'willingness to quit' with agreeing that dentists should be asking about smoking habits and offering support. No significant correlation was found between 'confidence to quit' and agreeing that dentists should be involved in smoking cessation activities (Table 3.19).

Table 3.19: Willingness to quit scale and confidence to quit scale by agreement with dental involvement in smoking cessation activities

Willingness to quit scale		
Extent to which agree that dentists should:	r_p	P
Ask if smoke	0.39	<0.001
Offer advice	0.45	<0.001
Provide counselling	0.33	0.001
Provide NRT	0.44	<0.001
Confidence to quit scale		
Extent to which agree that dentists should:	r_p	P
Ask if smoke	0.10	0.37
Offer advice	0.002	0.98
Provide counselling	0.07	0.49
Provide NRT	0.06	0.56

3.3.2.7 Smoking-related behaviours

The survey population comprised 185 (46.6%) individuals who had never smoked, 119 (30.0%) who were ex-smokers and 93 (23.4%) who were current smokers. In this population of smokers the tobacco products used were almost exclusively cigarettes - 61 (66.3%) - or roll-ups - 38 (41.3%), with 2 (2.2%) reporting that they used cannabis. One person smoked cigars. A significantly higher proportion of males smoked roll-ups than the proportion of females (X^2 =8.41, df =1, P=<0.001). No significant differences were found in the proportion of smokers using cigarettes or roll-ups by age group, occupational group or location.

<u>Age on starting smoking</u>

The age at which participants who reported being current smokers started smoking ranged from 9 to 32 years. The mean age of participants when they started smoking was 15.8 years (95%CI: 15.14, 16.49), with 44 (47.8%) being 15 years or younger, 39 (42.4%) being 16 – 19 years and 9 (9.8%) being over 20 years of age. No significant difference was found between proportions of younger and older participants [X^2=23.53; df=15; p=0.74], or between male and female participants, with regard to the age they started smoking [X^2=15.79; df=15; p=0.40].

Quantity of tobacco smoked per day

Current smokers were asked to report the quantity of tobacco smoked per day in categories of 10 or less cigarettes, 11 – 20 cigarettes, 21 – 30 cigarettes and 31 or more cigarettes. The quantity of tobacco smoked differed significantly between males and females with higher proportions of males compared with females being in the groups that smoked most (X^2 = 10.35, df =3, P=0.02).

Exposure to tobacco

One of the measures commonly used by researchers to determine the quantity of tobacco an individual has been exposed to over their lifetime is the pack-year. This is calculated by multiplying the number of years smoked (current age minus age on starting to smoke) by the reported quantity smoked per day. In this population the mean pack-years was 26.34 (95% CI: 22.49, 30.19), with a range from 3 – 98. No significant differences were found for mean pack-years by occupational group or location but unsurprisingly, mean pack-years were significantly higher in the older age group (t=6.04, P<0.001). The mean pack years for males was also significantly higher than for females (t = 3.72, P<0.001).

Nicotine dependence

The mean Fagerstrom nicotine dependence score for this population was 3.47 (95% CI: 3.03. 3.91) and the range was from 0 to 8. When the mean Fagerstrom nicotine dependence test was compared by age group, gender, occupational group and location the only significant difference found was a higher level of nicotine dependence in males compared with females ($t = 3.24$, $P = 0.002$).

Other smokers in house

The mean number of other smokers living in the same house as the participants was 0.53 (95%CI: 0.39, 0.67). The majority of smokers (55.4%) did not live with another smoker. There was no significant relationship shown between number of other smokers in the house with age group, gender, occupational group or location (Appendix 19, Table A2).

Quit attempts in previous two months

All smokers in the questionnaire study were asked about any attempts to cut down or stop smoking in the previous two months. The results showed that 36 (39.1%) had cut down in the previous two months, 22 (23.9%) had tried to quit and 30 (32.6%) had stopped for at least 24 hours.

The proportion of younger participants who had made quit attempts in the previous two months was larger than the proportion of older participants to do so, but this reached significance only for the proportions who had quit for at least 24 hours ($X^2 = 5.15$, df=1, $P = 0.02$) (Appendix 20, Tables A3 – A6). Larger proportions of females rather than males had made quit attempts but they did not reach statistical significance. Neither occupational group nor location was significantly associated with quit attempts in this population.

Intention to quit

With respect to future plans, 7 (7.6%) had set a quit date in the next 30 days, 51 (55.4%) were seriously considering stopping in the next 6 months, 16 (17.4%) did not plan to stop in the next 6 months and 18 (19.6%) had no plans ever to stop. A significantly larger proportion of older people had no intention to quit than younger people (X^2 = 9.56, df=3, P=0.02) (Appendix 21, Table A7).

3.3.2.8 Smoking cessation activities in a dental setting

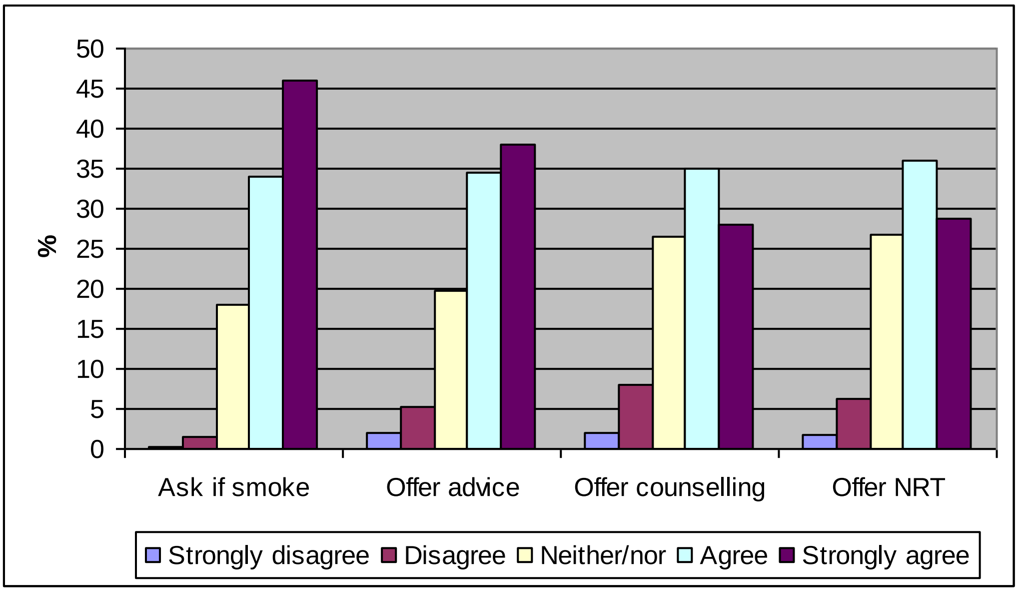
Attitudes to smoking cessation being offered in a dental setting

Participants were asked to respond on a five-point Likert scale to the four questions shown in Table 3.20 to assess their attitudes to smoking cessation activities being undertaken in a dental setting. The range of scores in each question is from 1 – strongly disagree – to 5 – strongly agree, and the mean score for each can be found in Table 3.22 and Figure 3.3. The full range of possible responses was found in this sample with one participant strongly disagreeing with all questions scoring 5 and 90 participants strongly agreeing with each statement who scored 20. These results indicate a high level of support for smoking cessation activities taking place in a dental setting.

Table 3.20: Mean frequency attitudes to dental involvement in smoking cessation activities

	Mean score	95% CI	
Do you think dentists should ask patients if they smoke?	4.24	4.16	4.32
Do you think dentists should offer advice about stopping smoking?	4.02	3.92	4.11
Do you think dentists should offer counselling to those wishing to quit?	3.79	3.69	3.89
Do you think dentists should offer NRT to those wishing to quit?	3.84	3.75	3.94

Figure 3.3: Agreement with smoking cessation activities in a dental setting



No significant differences in attitudes to smoking cessation activities in a dental setting were identified by age group, gender or location (Appendix 22). However, significantly smaller proportions of those in occupational groups requiring higher educational qualifications thought that dental staff should provide NRT as opposed to groups requiring lesser educational qualifications (Table 3.21).

As all participants, whether smokers or not, responded to these items, comparison of means tests were performed by smoking status. This showed that smokers scored significantly lower mean scores when asked if dentists should ask patients if they smoke, offer stop smoking advice to patients, or provide counselling to help smokers quit (Table 3.22).

Table 3.21: Attitudes to dental involvement in smoking cessation activities by occupational group

	Occupational group				F [df]	P
	1 Mean (95%CI)	2 Mean (95%CI)	3 Mean (95%CI)	4 Mean (95%CI)		
Ask if smoke	4.13 (3.96, 4.30)	4.25 (4.09, 4.41)	4.34 (4.18, 4.49)	4.33 (4.10, 4.55)	1.22 [3,329]	0.30
Offer advice	3.89 (3.68, 4.10)	3.92 (3.71, 4.13)	4.07 (3.89, 4.26)	4.17 (3.88, 4.47)	1.28 [3,329]	0.28
Provide counselling	3.76 (3.56, 3.95)	3.70 (3.49, 3.92)	3.82 (3.63, 4.01)	3.96 (3.65, 4.28)	0.77 [3,329]	0.51
Provide NRT	3.86^{1} (3.68, 4.03)	3.72^{1} (3.49, 3.94)	$3.76^{1,2}$ (3.56, 3.95)	4.25^{2} (3.99, 4.51)	3.88 [3,329]	0.01

*The suffixes show the significant differences in attitudes which existed between occupational groups

Table 3.22: Attitudes to dental involvement in smoking cessation activities by smoking status

	Smoking status			F [df]	P
	Never smoker Mean (95% CI)	Ex-smoker Mean (95% CI)	Current smoker Mean (95% CI)		
Ask if smoke	4.33^{2} (4.21,4.45)	4.29^{2} (4.14,4.43)	4.01^{1} (3.84,4.18)	5.06 [2,394]	0.007
Offer advice	4.12^{2} (3.99, 4.25)	4.14^{2} (3.96,4.33)	3.67^{1} (3.46,3.88)	8.09 [2,394]	<0.001
Provide counselling	3.86^{2} (3.73,4.00)	3.92^{2} (3.73,4.12)	3.49^{1} (3.30,3.69)	5.71 [2,394]	0.004
Provide NRT	3.78 (3.64,3.92)	3.97 (3.79,4.15)	3.80 (3.60,3.99)	1.41 [2,394]	0.25

*The suffixes show the significant differences in attitudes which existed between smoking status categories

<u>Dental staff offering smoking cessation support</u>

Smokers were asked to record their previous experience of dental staff asking them about their smoking status and offering smoking cessation support (Table 3.23).

Table 3.23: Past experience of dental involvement in smoking cessation activities

	Frequency of positive responses	
	Number	Percentage
Dentist asked whether you are a smoker?	64	69.6
Dentist advice about quitting smoking?	26	28.3
Dentist referred you to smoking cessation services?	15	16.3
Dentist given contact details smoking cessation services?	16	17.4

A significantly larger proportion of younger respondents than older respondents in this population reported having been asked by their dentist whether they smoke (X^2=5.54, df=1, P=0.02). No significant difference was found between past experience of smoking cessation activities in a dental setting with gender, occupational group or location.

3.3.2.9 Oral health

Oral health attitudes

Oral health-related quality of life

The OHIP-14 tool was used in this study to gauge the impact of oral health on the overall quality of life of this population of dental patients. A mean score of 4.38 (95%CI: 3.85, 4.91) was found, with a range of 0 – no impact – to 56 – greatly affected on each of the measures. The questions included in the OHIP-14 scale are detailed in Table 3.24.

Table 3.24: Oral health impact profile

OHIP 1	Have you ever had trouble pronouncing any words because of problems with your teeth, mouth or dentures?
OHIP 2	Have you felt your sense of taste has worsened because of problems with your teeth, mouth or dentures?
OHIP 3	Have you had painful aching in your mouth?
OHIP 4	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?
OHIP 5	Have you been self-conscious because of your teeth, mouth or dentures?
OHIP 6	Have you felt tense because of problems with your teeth, mouth or dentures?
OHIP 7	Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?
OHIP 8	Have you had to interrupt meals because of problems with your teeth, mouth or dentures?
OHIP 9	Have you found it difficult to relax because of problems with your teeth, mouth or dentures?
OHIP 10	Have you been a bit embarrassed because of your teeth, mouth or dentures?
OHIP 11	Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?
OHIP 12	Have you had difficulties doing your usual jobs because of problems with your teeth, mouth or dentures?
OHIP 13	Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?
OHIP 14	Have you been totally unable to function because of problems with your teeth, mouth or dentures?

Figure 3.4 shows the frequency with which participants experienced each of the 14 impacts on daily living, whilst Figure 3.5 details the frequency reported excluding ‘never’. It can be seen that physical impacts (pain and discomfort when eating) were most common, followed by psychological distress (feeling self-conscious and embarrassed).

Figure 3.4: Percentage of participants reporting each oral health-related impact

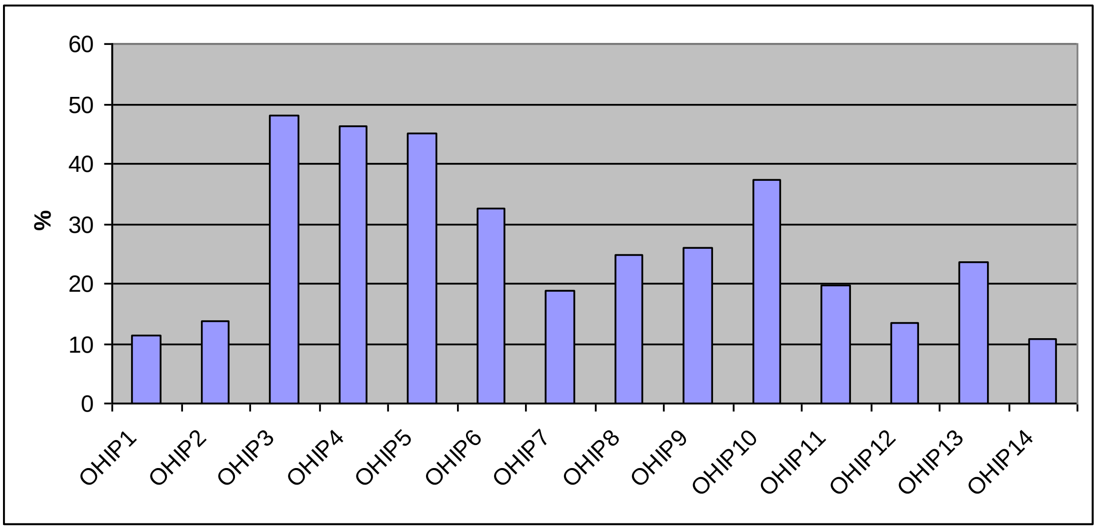
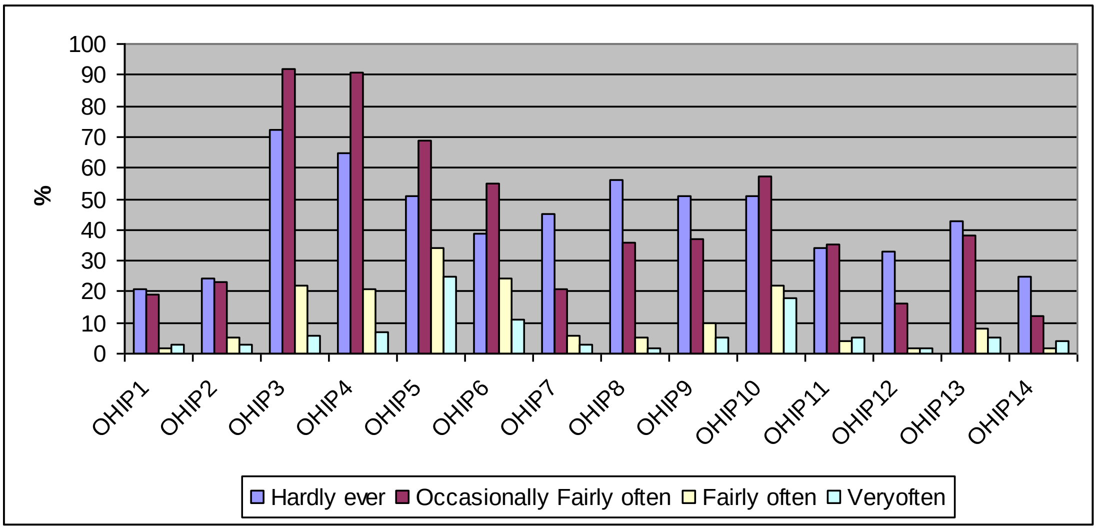


Figure 3.5: Percentage of participants reporting each oral health-related impact by frequency excluding "never"



Only 31.6% of the population sampled had not experienced any of the impacts on daily living measured by OHIP-14 in the previous twelve months. By convention, for example in the Adult Dental Health Survey (ADHS) 2009 (Nuttall et al. 2011), results of the OHIP-14 are analysed for those reporting an impact occasionally or more frequently, and by following this convention the results of OHIP-14 in this study sample can be compared with the wider population of the United Kingdom. In this survey population, 52.6% were affected occasionally or more often in at least one of the OHIP categories as compared with 39.0% in the ADHS 2009

(Nuttall et al. 2011). Forty three people (10.8%) had felt totally unable to function due to problems in their mouth on some occasion in the previous twelve months, much greater than the one percent found in the ADHS. An average of 3.7 impacts was experienced in this population compared with 1.2 in the ADHS. However, the average total OHIP score was much lower in this study population – 6.8 as opposed to 17.4 in the ADHS – indicating that participants experienced lower impacts on their daily lives despite an increased frequency than that found in the ADHS.

- Oral Health Impact Profile by age group

Results showed that younger participants experienced significantly greater impacts on oral health-related quality of life than older participants with respect to experiencing pain in their mouths (t=1.94, P=0.05), feeling self-conscious (t=2.97, P=0.003) and embarrassed (t=3.94, P<0.001) about oral problems, and having their ability to carry out normal tasks impaired (t=2.33, P=0.02).

- Oral Health Impact Profile by gender

Women were more likely to feel self-conscious about their teeth than men but no other gender differences were found (t=2.45, P=0.02).

- Oral Health Impact Profile by occupational group

Results demonstrated that participants whose occupation required lower levels of educational qualifications were more affected by oral health-related quality of life factors and this reached significance for feeling embarrassed by one’s mouth (F=4.02, df=3,329, P=0.008) and feeling completely unable to function due to oral health problems (F=0.01, df=3,329, P=0.01).

- Oral Health Impact Profile by location

A highly significant difference was found between the impact of oral health-related quality of life between the residents of Lochgilphead, 46.6% of whom had experienced oral health related impacts on their quality of life occasionally or more frequently in the past year, as opposed to 71.1% of residents of Dunoon. Participants from Dunoon had significantly higher mean scores in each of the individual OHIP-14 categories, with the exception of carrying out normal tasks (Appendix 23: Table A9).

- Oral Health Impact Profile by smoking status

The grouping variable smoking status significantly explained differences in mean impact scores for all OHIP items except OHIP 1. Current smokers had greater experience of OHIP 2, OHIP 3, OHIP 11 and OHIP 13 compared with those who had never smoked. Smokers compared with ex-smokers and never smokers had significantly greater mean scores for OHIP 4, OHIP 5, OHIP 7, OHIP 8, OHIP 10, OHIP 12 and OHIP 14. Current smokers had significantly higher mean scores compared with ex-smokers, who in turn had significantly greater mean scores than never smokers, for OHIP 6 and OHIP 9 (Table 3.25). Figure 3.6 shows the frequency of oral health items experienced by smoking status.

Figure 3.6: Percentage of participants reporting oral health-related impact by smoking status

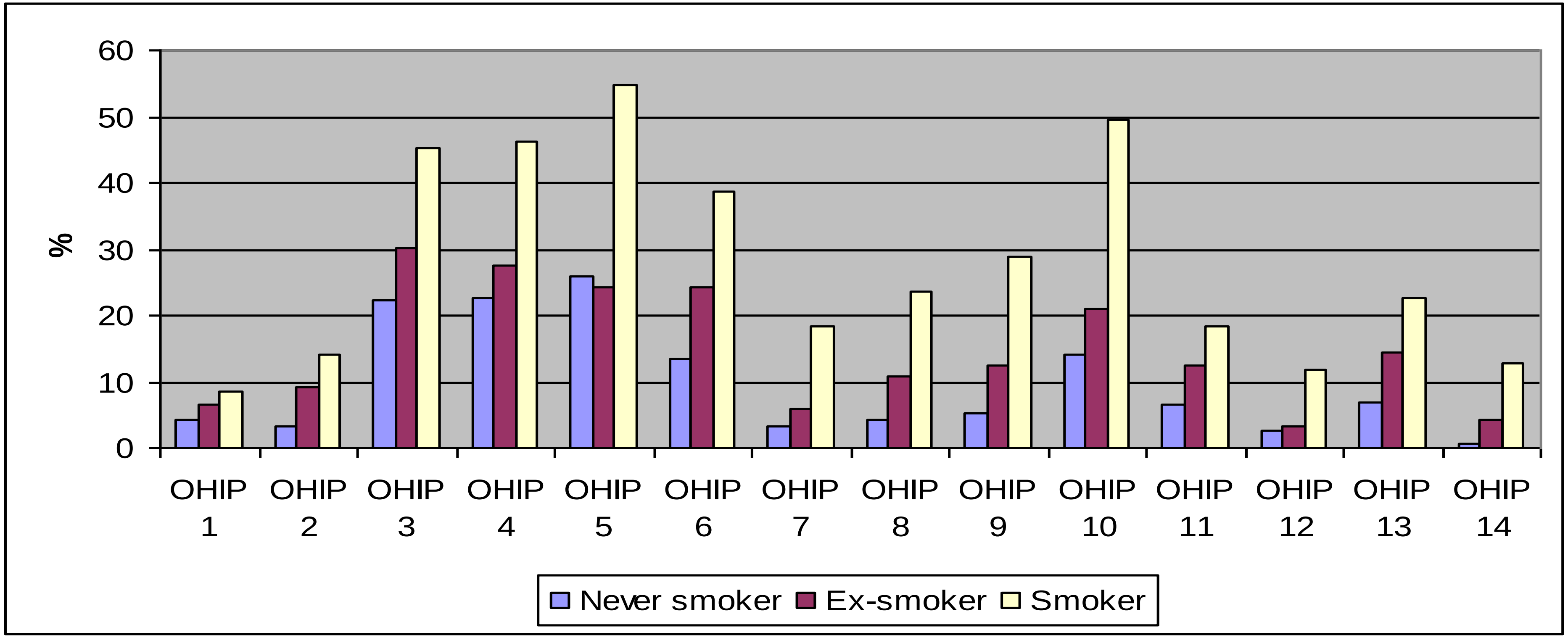


Table 3.25: Oral health-related quality of life by smoking status

	Smoking status			F [df]	P
	Never smoker Mean (95% CI)	Ex-smoker Mean (95% CI)	Current smoker Mean (95% CI)		
OHIP-1	0.14 (0.07,0.21)	0.22 (0.09,0.35)	0.26 (0.12,0.40)	1.32 [2,394]	0.27
OHIP-2	0.12^{1} (0.06, 0.18)	$0.29^{1,2}$ (0.15,0.42)	0.42^{2} (0.23,0.61)	6.65 [2,394]	0.001
OHIP-3	0.70^{1} (0.57,0.83)	$0.89^{1,2}$ (0.70,1.09)	1.17^{2} (0.92,1.43)	6.62 [2,394]	0.001
OHIP-4	0.65^{1} (0.52,0.78)	0.86^{1} (0.67,1.04)	1.23^{2} (0.96,1.49)	9.66 [2,394]	<0.001
OHIP-5	0.71^{1} (0.55,0.86)	0.82^{1} (0.60,1.03)	1.74^{2} (1.43,2.05)	24.17 [2,394]	<0.001
OHIP-6	0.40^{1} (0.28,0.52)	0.75^{2} (0.54,0.96)	1.10^{3} (0.82,1.37)	13.85 [2,394]	<0.001
OHIP-7	0.15^{1} (0.08,0.22)	0.29^{1} (0.17,0.42)	0.58^{2} (0.38,0.78)	12.14 [2,394]	<0.001
OHIP-8	0.23^{1} (0.15,0.30)	0.40^{1} (0.26,0.53)	0.66^{2} (0.45,0.86)	10.84 [2,394]	<0.001
OHIP-9	0.22^{1} (0.14,0.29)	0.48^{2} (0.32,0.64)	0.84^{3} (0.60,1.08)	17.84 [2,394]	<0.001
OHIP-10	0.45^{1} (0.33,0.57)	0.67^{1} (0.48,0.86)	1.51^{2} (1.20,1.81)	29.99 [2,394]	<0.001
OHIP-11	0.20^{1} (0.12,0.28)	$0.39^{1,2}$ (0.22,0.55)	0.57^{2} (0.37,0.77)	7.39 [2,394]	0.001
OHIP-12	0.12^{1} (0.07,0.18)	0.16^{1} (0.06,0.26)	0.40^{2} (0.23,0.57)	7.63 [2,394]	0.001
OHIP-13	0.25^{1} (0.17,0.34)	$0.44^{1,2}$ (0.28,0.60)	0.69^{2} (0.47,0.91)	8.65 [2,394]	<0.001
OHIP-14	0.05^{1} (0.01,0.08)	0.18^{1} (0.07,0.28)	0.44^{2} (0.24,0.64)	14.13 [2,394]	<0.001

*The suffixes show the significant differences in OHIP which existed between smoking status categories

Oral health-related behaviours: dental attendance

In this sample, 355 respondents or 89.2% of the total had attended their dentist in the previous year. Dental attendance in the previous year was not affected by age group, gender, occupational group, or location. A significant difference was found with never smokers and ex-smokers attending in the previous year more frequently than current smokers (X^2=6.79, df=2, P=0.03).

When asked for their reason for dental attendance in the previous twelve months, 226 (56.6%) attended for a dental examination, 151 (37.8%) attended due to problems with their mouth and 21 (5.3%) for another reason. Age group and gender did not impact significantly on reason for dental attendance in the previous year.

Those engaged in occupations requiring higher educational qualifications were significantly more likely to have attended their dentist for a dental examination rather than due to oral problems (X^2=25.24, df=6, P<0.001). A significantly greater proportion of participants living in Dunoon (57.7%) had attended due to oral problems than the proportion of those in Lochgilphead (31.6%) (X^2=23.12, df=2, P<0.001). There was a significant association between current smoking status with reason for dental attendance (X^2=22.30, df=4, P<0.001).

Oral health-related behaviours: toothbrushing

Seventy-eight (19.5%) of participants reported brushing their teeth once daily, 279 (69.9%) reported brushing twice daily and 41 (10.3%) reported toothbrushing more than twice daily.

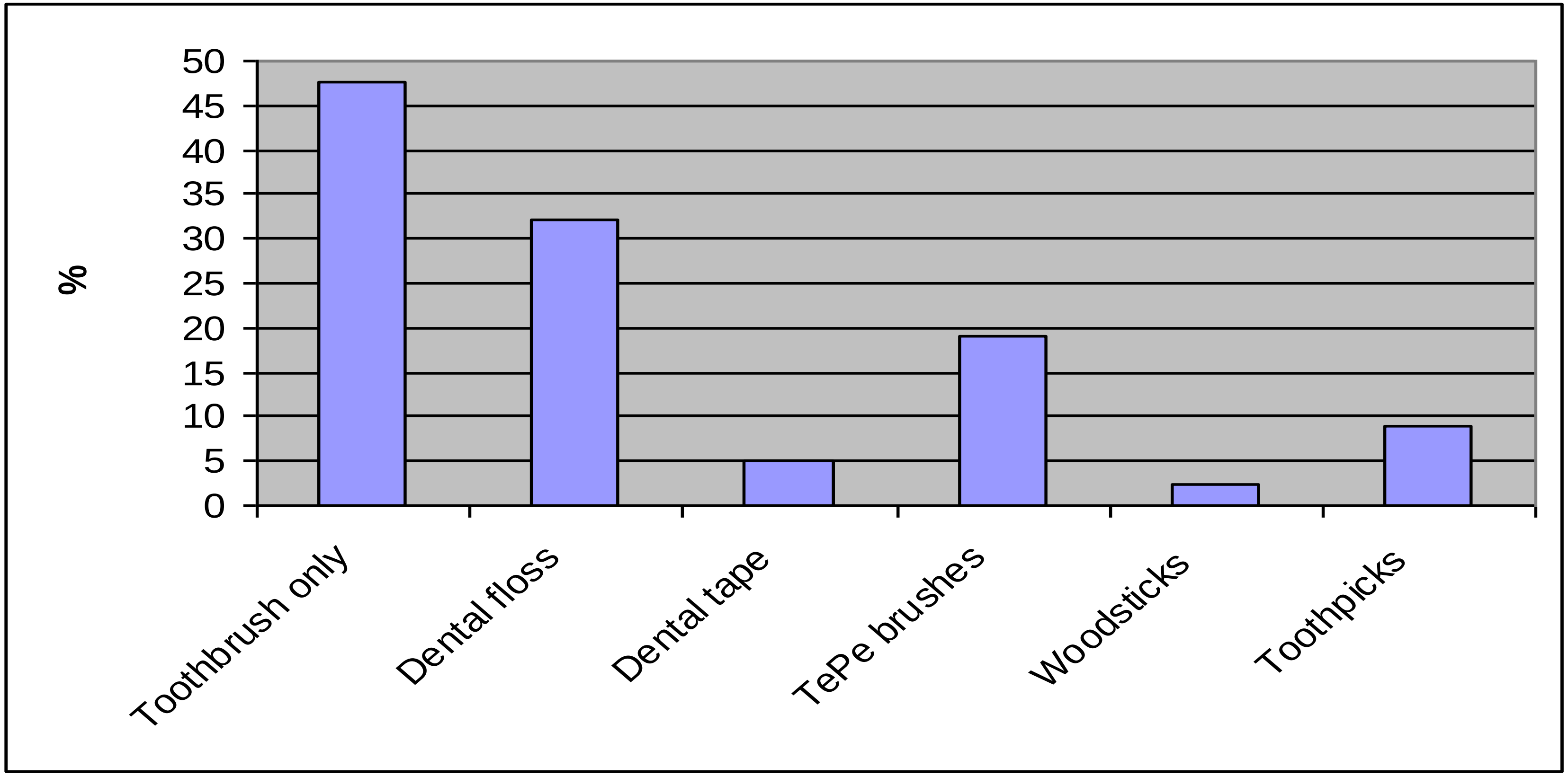
No significant association was found between frequency of toothbrushing and age group, occupational group, location or smoking status in this population. A significantly higher proportion of males reported brushing their teeth only once per day as opposed to women (X^2=18.22, df=2, P<0.001).

Oral health-related behaviours: interdental cleaning

Most respondents in this survey used either dental floss or TePe brushes for interdental cleaning (Figure 3.7), although a large minority (47.5%) did not use any method for cleaning between their teeth other than toothbrushing.

No significant association was found between interdental cleaning and age group, occupational group, location or smoking status in this population. A significantly higher proportion of females reported using interdental cleaning aids as opposed to males (X^2=16.95, df=1, P<0.001).

Figure 3.7: Frequency of use of interdental cleaning aids



3.3.2.10 Periodontal status

Periodontal status – by complexity of treatment need

The periodontal status of participants in the self-administered questionnaire study was measured using the Basic Periodontal Examination (BPE). A calibration exercise was undertaken by the principal researcher and a Consultant in Restorative Dentistry (AFH) to determine the reliability of the data recorded. An intraclass correlation of 0.90 was found between the two examiners. There are varying opinions as to what level of reliability can be considered adequate but the intraclass correlation found in this calibration exercise exceeds the level of 0.85 recommended by Weiner and Stewart (1984). The same methodology was used to assess intra-examiner calibration and this was found to be acceptable with an intraclass correlation of 0.92.

The mean whole mouth total BPE score in this sample was 11.6. The mean for each individual sextant is found in Table 3.26.

Table 3.26: Mean BPE per sextant

Sextant	Mean BPE score	95% CI	
Upper left	2.41	2.15	2.68
Upper mid	1.80	1.57	2.01
Upper right	2.45	2.17	2.72
Lower right	2.24	1.98	2.49
Lower mid	1.89	1.78	2.01
Lower left	2.30	2.04	2.57

Table 3.27 shows the distribution of the three categories of complexity of periodontal treatment need across this study sample.

Table 3.27: Frequency of complexity of periodontal treatment need category

Complexity of periodontal treatment need category	Number	Percent
Complexity 1	331	83.2
Complexity 2	48	12.1
Complexity 3	19	4.8

Table 3.28 demonstrates the demographic profile and smoking status of the study population by category of complexity of periodontal treatment need.

- Complexity of periodontal treatment need category by age group

Proportions of younger and older participants were similar in Complexity groups 1 and 2, but the proportion of older participants in the Complexity 3 group was larger than the proportion of younger participants although this failed to reach statistical significance at 0.05 level (Table 3.28).

- Complexity of periodontal treatment need category by gender

A significantly smaller proportion of males compared with females were found in the Complexity 1 and Complexity 2 groups, and correspondingly, a larger proportion of males than females were found in the Complexity 3 group (Table 3.28).

- Complexity of periodontal treatment need category by occupational group

An inverse trend was apparent in the proportions of those with more complex periodontal treatment needs by the increasing educational qualifications required by occupational group. This was particularly marked in the occupational group requiring the lowest level of educational qualifications and reached statistical significance (Table 3.28).

- Complexity of periodontal treatment need category by location

A significant result was found with respect to location and complexity of periodontal treatment need category with a threefold higher proportion of Dunoon residents being in the Complexity 3 group as compared with Lochgilphead participants (Table 3.28).

- Complexity of periodontal treatment need category by reported smoking status

The results show a highly significant association between smoking and poor periodontal health with only 1% of never smokers being found in the highest complexity of periodontal treatment need category as opposed to 12% of current smokers (Table 3.28).

Table 3.28: Complexity of periodontal treatment need category by demographic profile and reported smoking status

Complexity of periodontal treatment need						
		Complexity 1 n (%)	Complexity 2 n (%)	Complexity 3 n (%)	X^2 [df]	P
Age group	Younger	167 (83.5)	28 (14.0)	5 (2.5)	5.61	0.06
	Older	164 (82.8)	20 (10.1)	14 (7.1)	[2]	
Gender	Male	119 (76.8)	25 (16.1)	11 (7.1)	7.60	0.02
	Female	212 (87.2)	23 (9.5)	8 (3.3)	[2]	
Occupation	1	74 (75.5)	13 (13.3)	11 (11.2)		
	2	73 (83.0)	15 (17.0)	0 (0.0)	17.27	0.01
	3	83 (87.4)	8 (8.4)	4 (4.2)	[6]	
	4	43 (82.7)	8 (15.4)	1 (1.9)		
Location	L'gilphead	261 (86.7)	30 (10.0)	10 (3.3)	11.81	0.01
	Dunoon	70 (72.2)	18 (18.6)	9 (9.3)	[2]	
Smoking status	Never smoker	181 (97.8)	2 (1.1)	2 (1.1)	133.54	<0.001
	Ex-smoker	107 (89.9)	6 (5.0)	6 (5.0)	[4]	
	Current smoker	42 (45.2)	40 (43.0)	11 (11.8)		

- Complexity of periodontal treatment need category per sextant by smoking status

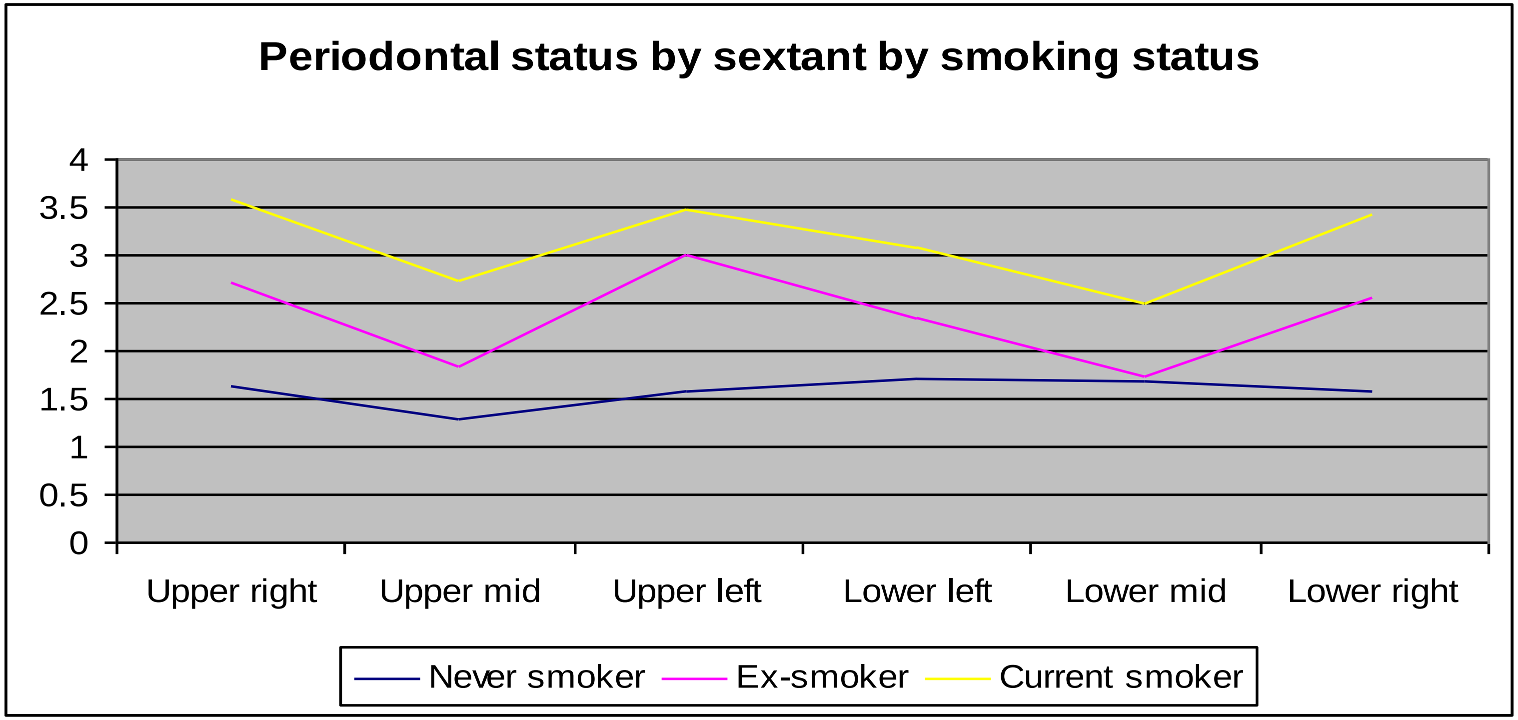
Table 3.29 shows that the grouping variable smoking status significantly explains differences in complexity of periodontal treatment need. Current smokers had higher mean complexity of periodontal treatment need compared with those who had never smoked in the lower left sextant. In the upper mid and lower mid sextants, current smokers had significantly higher mean scores for complexity of treatment need than either ex-smokers or never smokers. In both the upper right and lower right sextants, mean scores for complexity of periodontal treatment need increased significantly between those who had never smoked and ex-smokers, and between ex-smokers and those who had never smoked. In the upper left sextant mean scores for both ex-smokers and current smokers were significantly higher than for never smokers. A graphical representation can be found in Figure 3.8.

Table 3.29: Complexity of periodontal treatment need category by sextant by smoking status

Sextant	Smoking status	Mean (95% CI)	F [df]	P
Upper right	Never smoker	1.64^{1} (1.35, 1.93)	17.89 [2, 394]	<0.001
	Ex-smoker	2.72^{2} (2.19, 3.26)		
	Smoker	3.57^{3} (2.91, 4.23)		
Upper mid	Never smoker	1.30^{1} (1.05, 1.54)	14.25 [2, 394]	<0.001
	Ex-smoker	1.83^{1} (1.42, 2.24)		
	Smoker	2.75^{2} (2.20, 3.31)		
Upper left	Never smoker	1.58^{1} (1.20, 1.86)	18.96 [2, 394]	<0.001
	Ex-smoker	2.99^{2} (2.39, 3.60)		
	Smoker	3.48^{2} (2.85, 4.11)		
Lower left	Never smoker	1.70^{1} (1.38, 2.01)	9.61 [2, 394]	<0.001
	Ex-smoker	$2.35^{1,2}$ (1.85, 2.85)		
	Smoker	3.08^{2} (2.51, 3.65)		
Lower mid	Never smoker	1.68^{1} (1.53, 1.83)	17.93 [2, 394]	<0.001
	Ex-smoker	1.75^{1} (1.60, 1.90)		
	Smoker	2.51^{2} (2.18, 2.83)		
Lower right	Never smoker	1.59^{1} (1.31, 1.87)	15.91 [2, 394]	<0.001
	Ex-smoker	2.55^{2} (2.00, 3.09)		
	Smoker	3.41^{3} (2.77, 4.05)		

*The suffixes show the significant differences in complexity of periodontal treatment need by sextant which existed between smoking status categories

Figure 3.8: Periodontal status by sextant by smoking status



- Complexity of periodontal treatment need category by reported medical condition

A significantly greater proportion of those with the highest complexity of periodontal treatment needs are receiving medical treatment than those in Complexity groups 1 and 2. A trend towards higher prevalence of disease with increasing complexity of periodontal treatment need is found in medication use, angina, high blood pressure, heart attack and diabetes and results between groups reached significance for heart attack and infectious diseases (Table 3.30).

Table 3.30: Complexity of periodontal treatment need category by reported medical condition

Reported medical condition	Complexity of periodontal treatment need			X^2 [df]	P
	Complexity 1 n (%)	Complexity 2 n (%)	Complexity 3 n (%)		
Receive treatment	111 (33.5)	19 (39.6)	13 (68.4)	9.82 [2]	0.01
Taking medication	171 (51.7)	33 (68.8)	12 (63.2)	5.57 [2]	0.06
Angina	13 (3.9)	3 (6.3)	2 (10.5)	2.19 [2]	0.34
Hypertension	57 (17.2)	10 (20.8)	6 (31.6)	2.70 [2]	0.26
Heart attack	7 (2.1)	3 (6.3)	2 (10.5)	6.30 [2]	0.04
Infectious diseases	2 (6.0)	2 (4.2)	1 (5.3)	6.87 [2]	0.03
Lung diseases	29 (8.8)	9 (18.8)	2 (10.5)	4.63 [2]	0.10
Epilepsy	3 (0.9)	0 (0.0)	0 (0.0)	0.61 [2]	0.74
Diabetes	13 (3.9)	2 (4.2)	2 (10.5)	1.92 [2]	0.38
Bleeding problems	30 (9.1)	8 (16.7)	1 (5.3)	3.21 [2]	0.20
Allergies	76 (23.0)	9 (18.8)	4 (21.1)	0.45 [2]	0.80
Pregnant	7 (2.1)	1 (2.1)	0 (0.0)	0.41 [2]	0.82

<u>Periodontal status and smoking</u>

- Complexity of periodontal treatment need and smoking-related health knowledge

Complexity of periodontal treatment need and smoking-related health knowledge were not found to be significantly associated in this population, with the exception of liver disease where significantly smaller proportions of those with the most complex treatment needs answered correctly (X^2=6.72, df=2, P=0.04).

- Complexity of periodontal treatment needs and oral health-related quality of life

Figure 3.9 shows the proportion of participants in the mild, moderate and severe complexity of periodontal treatment need groups experiencing oral health-related impacts on their quality of life.

The grouping variable 'complexity of periodontal treatment need' significantly explained differences in mean oral health-related quality of life (OHIP) scores except in OHIP-12 (difficulty completing everyday tasks) and OHIP-13 (finding life less satisfying). Those with the highest complexity of periodontal treatment need had significantly higher mean impact scores for OHIP than those in the lowest complexity groups for OHIP-4, OHIP-6, OHIP-7, OHIP-8 and OHIP-9. For OHIP-1, OHIP-2 and OHIP-11, those in the highest grouping for complexity of treatment need had significantly higher mean OHIP scores than those in the moderate and lowest complexity groups. The grouping variable complexity of periodontal treatment need significantly explained differences in mean scores for OHIP items 3, 5 and 14. However the multiple comparison Scheffe test was conducted none of these separate tests reached 5% level of significance (Table 3.31).

Figure 3.9: Percentage of participants reporting each oral health-related impact by complexity of periodontal treatment need

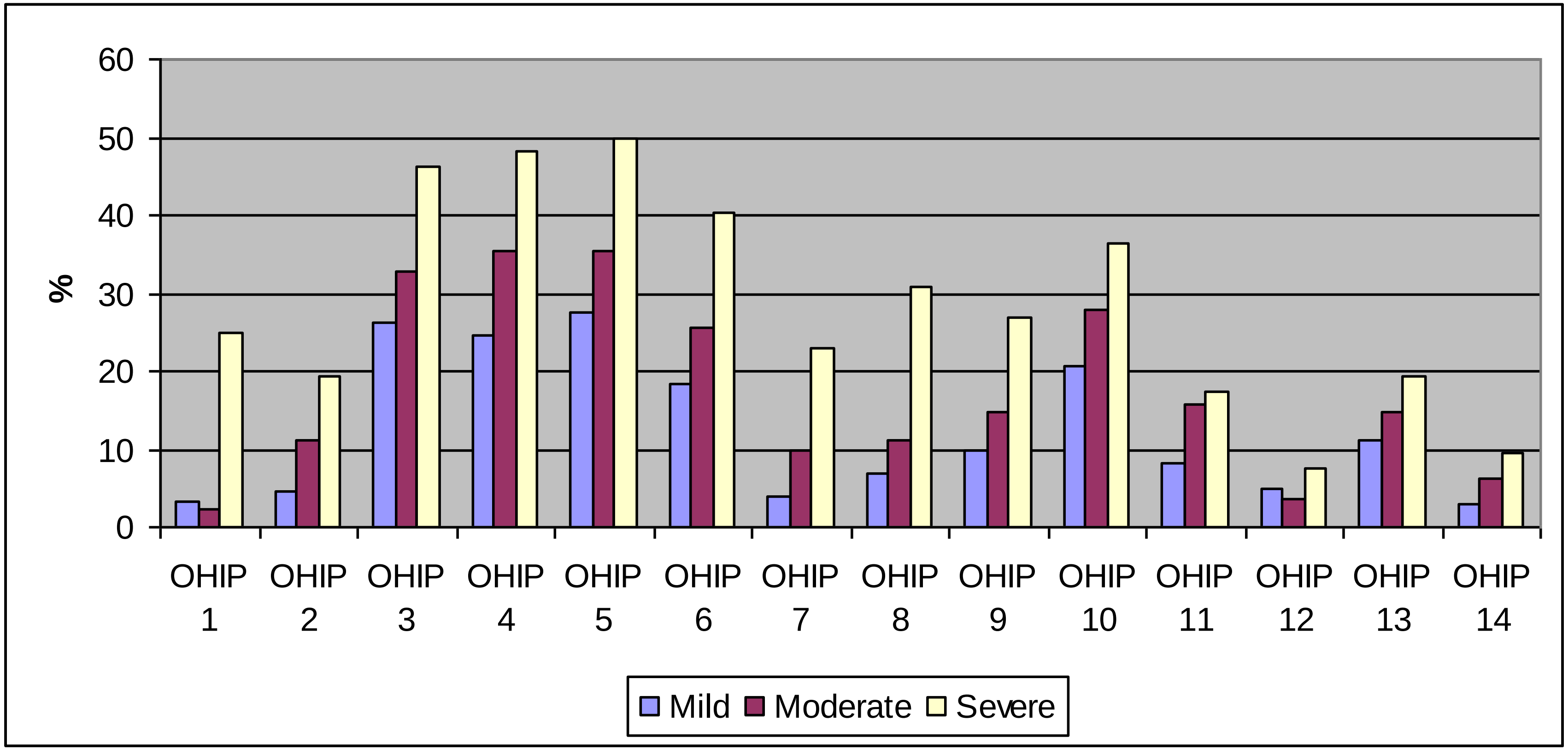


Table 3.31: Complexity of periodontal treatment need category by mean Oral Health Impact Profile scores

Mean Oral Health Impact Profile scores	Complexity of periodontal treatment need			F [df]	P
	Complexity 1 Mean (95% CI)	Complexity 2 Mean (95% CI)	Complexity 3 Mean (95% CI)		
OHIP-1 Pronouncing words	0.18^{1*} (0.12,0.24)	0.17^{1} (0.02,0.32)	0.53^{2} (0.01,1.04)	3.00 [2,395]	0.05
OHIP-2 Sense of taste worse	0.20^{1} (0.13,0.27)	0.33^{1} (0.13,0.54)	0.79^{2} (0.16,1.42)	7.40 [2,395]	0.01
OHIP-3 Painful aching mouth	0.81^{1} (0.70,0.91)	1.15^{1} (0.79,1.51)	1.26^{1} (0.62,1.90)	3.68 [2,395]	0.03
OHIP-4 Uncomfortable to eat	0.77^{1} (0.66,0.87)	1.17^{1,2} (0.80,1.53)	1.47^{2} (0.82,2.12)	6.67 [2,395]	0.01
OHIP-5 Self-conscious	0.89^{1} (0.76,1.03)	1.48^{1} (1.09,1.87)	1.32^{1} (0.60,2.04)	5.22 [2,395]	0.01
OHIP-6 Tense	0.57^{1} (0.49,0.68)	1.00^{1,2} (0.64,1.36)	1.53^{2} (0.80,2.25)	9.88 [2,395]	<0.001
OHIP-7 Unsatisfactory diet	0.22^{1} (0.16,0.28)	0.56^{1,2} (0.30,0.82)	0.89^{2} (0.27,1.51)	12.96 [2,395]	<0.001
OHIP-8 Interrupt meals	0.32^{1} (0.25,0.39)	0.63^{1,2} (0.35,0.90)	0.84^{2} (0.28,1.40)	7.70 [2,395]	0.01
OHIP-9 Difficult to relax	0.36^{1} (0.28,0.44)	0.71^{1,2} (0.38,1.04)	1.11^{2} (0.53,1.68)	9.83 [2,395]	<0.001
OHIP-10 Felt embarrassed	0.67^{1} (0.55,0.79)	1.25^{1} (0.85,1.65)	1.16^{1} (0.47,1.84)	6.63 [2,395]	0.01
OHIP-11 Irritable with others	0.30^{1} (0.22,0.37)	0.38^{1} (0.15,0.60)	1.05^{2} (0.40,1.70)	8.76 [2,395]	<0.001
OHIP-12 Difficulty with jobs	0.17 (0.11,0.22)	0.31 (0.10,0.53)	0.42 (0.04,0.88)	2.82 [2,395]	0.06
OHIP-13 Life less satisfying	0.39 (0.30,0.47)	0.50 (0.23,0.77)	0.58 (0.06,1.10)	0.79 [2,395]	0.46
OHIP-14 Unable to function	0.15^{1} (0.09,0.21)	0.27^{1} (0.06,0.48)	0.47^{1} (0.04,0.99)	3.35 [2,392]	0.04

*The suffixes show the significant differences in mean OHIP scores which existed between complexity of treatment need categories

- Complexity of periodontal treatment need by pack years

The grouping variable complexity of periodontal treatment need significantly explained differences in mean pack years (Table 3.32).

Table 3.32: Complexity of periodontal treatment need category by pack years

	Complexity of periodontal treatment category			F [df]	P
	Complexity 1	Complexity 2	Complexity 3		
Mean life pack years	17.87[1*]	31.54[2]	39.00[2]	10.04 [2,89]	<0.001
95% CI	(14.03, 21.70)	(25.77, 37.31)	(21.18, 56.82)		

*The suffixes show the significant differences in pack years which existed between complexity of treatment need categories

- Complexity of periodontal treatment need by nicotine dependence

The grouping variable complexity of periodontal treatment need significantly explained differences in mean nicotine dependence score. Those participants in Complexity 1 group had lower scores for nicotine dependence compared with those in Complexity 2 and 3 (Table 3.33).

Table 3.33: Complexity of periodontal treatment need category by nicotine dependence

	Complexity of periodontal treatment category			F [df]	P
	Complexity 1	Complexity 2	Complexity 3		
Mean nicotine dependence (95% CI)	2.71[1*] (2.04, 3.37)	4.10[2] (3.51, 4.69)	4.00[2] (2.41, 5.59)	5.20 [2,89]	0.007

*The suffixes show the significant differences in nicotine dependence which existed between complexity of treatment need categories

<u>Complexity of periodontal treatment needs and smoking cessation activities in a dental setting</u>

The grouping variable 'complexity of periodontal treatment need' significantly explains differences in mean scores for agreement that dentists should offer stop smoking advice and that they should provide stop smoking counselling. The grouping variable complexity of periodontal treatment need significantly explained differences in mean scores for smoking cessation activities in the dental setting. However when the multiple comparison Scheffe test was conducted none of these separate tests reached 5% level of significance (Table 3.34).

Table 3.34: Complexity of periodontal treatment need category by attitudes to smoking cessation activities in a dental setting

	Complexity of periodontal treatment need			F [df]	P
	Complexity 1 n=331	Complexity 2 n=48	Complexity 3 n=19		
Should dentist ask if smoke? Mean (95% CI)	4.27 (4.17,4.35)	4.02 (3.76,4.28)	4.37 (3.97,4.77)	2.14 [2,395]	0.12
Should dentist offer smoking advice? Mean (95% CI)	4.07[1] (3.97,4.18)	3.77[1] (3.49,4.05)	3.68[1] (3.13,4.24)	3.13 [2,395]	0.05
Should dentist provide counselling? Mean (95% CI)	3.86[1] (3.76,3.97)	3.42[1] (3.12,3.71)	3.53[1] (2.96,4.09)	4.96 [2,395]	0.007
Should dentist provide NRT? Mean (95% CI)	3.84 (3.74,3.95)	3.83 (3.55,4.12)	3.84 (3.28,4.40)	0.02 [2,395]	0.99

*The suffixes show the significant differences agreement with dentists offering smoking cessation which existed between complexity of treatment needs categories

- Complexity of periodontal treatment needs by past experience of smoking cessation activity in a dental setting

No significant difference was found in proportions of participants who had been offered smoking cessation activities in a dental setting by the complexity of their periodontal treatment need (Appendix 24, Table A10).

<u>Complexity of periodontal treatment needs and oral health behaviours</u>

- Complexity of periodontal treatment needs by dental attendance

The proportion of respondents who had attended their dentist in the previous twelve months did not differ significantly by complexity of periodontal treatment need category. However, the proportion of those attending their dentist in the previous twelve months due to oral problems was significantly higher in those with more complex periodontal treatment needs than in those with less complex treatment needs (Appendix 25, Table A11).

- Complexity of periodontal treatment needs by oral health-related behaviours

A large majority of participants in all complexity of periodontal treatment need categories reported brushing their teeth twice per day. No statistically significant association was found between complexity of treatment need and frequency of brushing teeth. No significant difference was found in the proportion of those using interdental aids with complexity of periodontal treatment need (Appendix 26, Table A12).

3.3.2.11 Summary of findings of prevalence study

The total of 398 participants in the prevalence study had a mean age of 49.2 years and males represented 39% of the sample. Twenty three percent of the participants were current smokers, while 30% were ex-smokers and 47% had never smoked. A larger proportion of smokers were found in the younger age group and in occupations which required a low level of educational achievement.

When responding to questions about which health conditions were smoking-related, current smokers tended to underestimate the link between health conditions and smoking, and never smokers tended to overestimate the link.

Mean scores for those participants with the greatest lifetime exposure to tobacco and highest nicotine dependence were significantly lower on analysis with the ‘confidence to quit’ scale than those with lower exposure and dependence. The mean scores for quit activities in the previous two months were highest for those with a high score on the ‘willingness to quit’ scale and for both the ‘willingness to quit’ scale and the ‘confidence to quit’ scale with respect to readiness to quit in future.

When analysing the ‘willingness to quit’ and ‘confidence to quit’ scales by mean scores for complexity of periodontal treatment need, no significant relationship was found. Higher mean scores were found with the ’willingness to quit’ scale for functional oral health-related quality of life e.g. difficulty in eating, experiencing pain, but significant effects were not found with the ‘confidence to quit’ scale. A significantly greater willingness to quit was found as mean scores for agreement with dentists undertaking smoking cessation activities increased. This was not found with respect to confidence in quitting.

The participants in this study smoked either cigarettes or roll-ups, and the mean age of starting smoking was 15.8 years. Both lifetime exposure to tobacco and nicotine dependence were found to be significantly higher in male participants as compared to female participants.

Thirty nine percent of participants indicated that they had cut down on the number of cigarettes they smoked in the previous two months, and 63% stated that they wished to quit in the coming six months. Almost 20% of participants indicated that they never intended to quit smoking.

Fewer than 10% of participants disagreed or strongly disagreed that dentists should offer smoking cessation advice and support to patients who smoke, but despite the high levels of support, smokers had significantly lower mean scores for support than ex-smokers and those who had never smoked.

A significantly greater proportion of younger respondents reported being provided with smoking cessation advice and support from their dentist than the proportion of older people.

Sixty eight percent of the participants reported experiencing an oral health impact in the previous twelve months with each individual experiencing 3.7 impacts as compared with 1.2 in the Adult Dental Health Survey (Nuttall et al. 2011). However the mean total score for OHIP was lower in this population than in the

ADHS indicating that they experienced more frequent impacts of oral health but of lower intensity.

Younger participants had higher mean scores for several impacts on oral health-related quality of life than older participants, including experiencing pain, self-consciousness and embarrassment. A higher proportion of women rather than men experienced embarrassment due to oral problems. Smoking status explained significant differences in oral health impact scores for all OHIP items with the exception of ‘difficulty in pronouncing words’, with current smokers experiencing the greatest impact.

Reported dental attendance in the previous year reached 89% in this population with 57% attending for routine care and 38% for emergency care. A significantly greater proportion of current smokers were likely to have attended for emergency care than ex-smokers or never smokers.

Eighty percent of this population reported brushing their teeth at least twice daily, with a higher proportion of men than women stating they brushed only once per day. Almost 50% of this population did not use interdental cleaning aids, but dental floss and TePe brushes were those most commonly used. Significantly higher proportions of women rather than men used interdental cleaning aids.

Using the Basic Periodontal Examination (BPE) the participants were divided into three groups by complexity of periodontal treatment need with 83% having low complexity of periodontal treatment need, 12% having moderate complexity of periodontal treatment need and 5% having high complexity of periodontal treatment need. A higher proportion of the following groups were found to have high complexity of periodontal treatment need: males, those with occupations requiring low educational qualifications, residents of Dunoon, those with previous experience of myocardial infarction and infectious disease, and current smokers. Twelve percent of current smokers are in the highest complexity group as opposed to 1% of never smokers.

The proportion of those in the high complexity of periodontal treatment need group increased with higher lifetime exposure to nicotine and nicotine dependence.

Complexity of periodontal treatment need explained differences in oral health-related quality of life, with increasing complexity being related to increasing negative impacts on oral health-related quality of life.

A higher proportion of those with high complexity of periodontal treatment need than those with moderate or low needs reported their last dental attendance having been for emergency rather than routine care. However, no significant differences in complexity of periodontal treatment need and frequency of toothbrushing or use of interdental cleaning aids were found.

3.4 Using Structural Equation Modelling to model a smoking cessation intervention for primary dental care in remote-rural Scotland

A path model employing structural equation modelling (SEM) procedures was tested to incorporate the observed questionnaire responses into a small set of latent variables. The advantage of such a procedure was that the interpretation was aided by conducting an overall analysis that incorporated, what is essentially, a factor analysis and multiple regression into a single statistical routine. The error of measurement was specified in the model and estimated in parallel to the substantive relationships between the latent i.e. periodontal status and oral health-related quality of life and raw i.e. age and smoking status variables. The standardised estimates that result from the analysis were disattenuated and therefore provided a clearer understanding of the underlying strength of the relationships without the confounding of measurement error.

A hypothesised model was compiled that was based on familiarity with the previous research in this sphere. Its development specified the relationships between observed variables and the factor ‘oral health-related quality of life’. The independent variables used to construct the model included age, smoking status and periodontal status. Periodontal status was thought to be most closely related to the dependent variable i.e. oral health-related quality of life and so complexity of periodontal treatment need became the assigned proximal variable. Age and smoking status were entered as the assigned distal variables. All measures included in the model were normally distributed.

The path model was constructed using the accessible diagrammer in SPSS AMOS version 17. Measurement errors were entered for the BPE measurement observed for each sextant (e5 – e10) as these informed the periodontal status which is a non-independent variable. The disturbance error term of the periodontal status latent variable was represented by d1. Similarly the latent variable oral health-related quality of life required a disturbance error term d2 derived from the indicator variables, namely: OHIPA (e3) and OHIPB (e4). The measurement errors in this model were all assigned a regression coefficient of ‘1’ to facilitate the convergence of the estimation procedures. Model parameters were derived using the maximum likelihood estimation as this is the most efficient method. The correlation between the two distal variables i.e. ‘smoking status’ and ‘age’ was entered as this enables their effects on periodontal status and oral health-related quality of life to be considered independently of each other in the model as a whole.

The model was then processed using the complete data set and with no missing values (n=398). All resulting coefficients were within accepted limits. A maximum number of six iterations were required to reach convergence. The standardised model showed all paths to be statistically significant (see Figure 3.10).

The fit of the observed data to the specified model was analysed using a variety of fit indices. The values of three of the more commonly cited fit indices were as follows: CFI=0.969, TLI=0.959, RMSEA=0.066 and these represent a good fit of the data to the model. Table 3.35 shows the correlation matrix of the variables included in the path model.

Note that both smoking status and periodontal status had direct and significant relationships with oral health-related quality of life. In addition, smoking status had a further effect on oral health-related quality of life but indirectly as shown by the significant coefficient (0.40) between smoking and periodontal status.

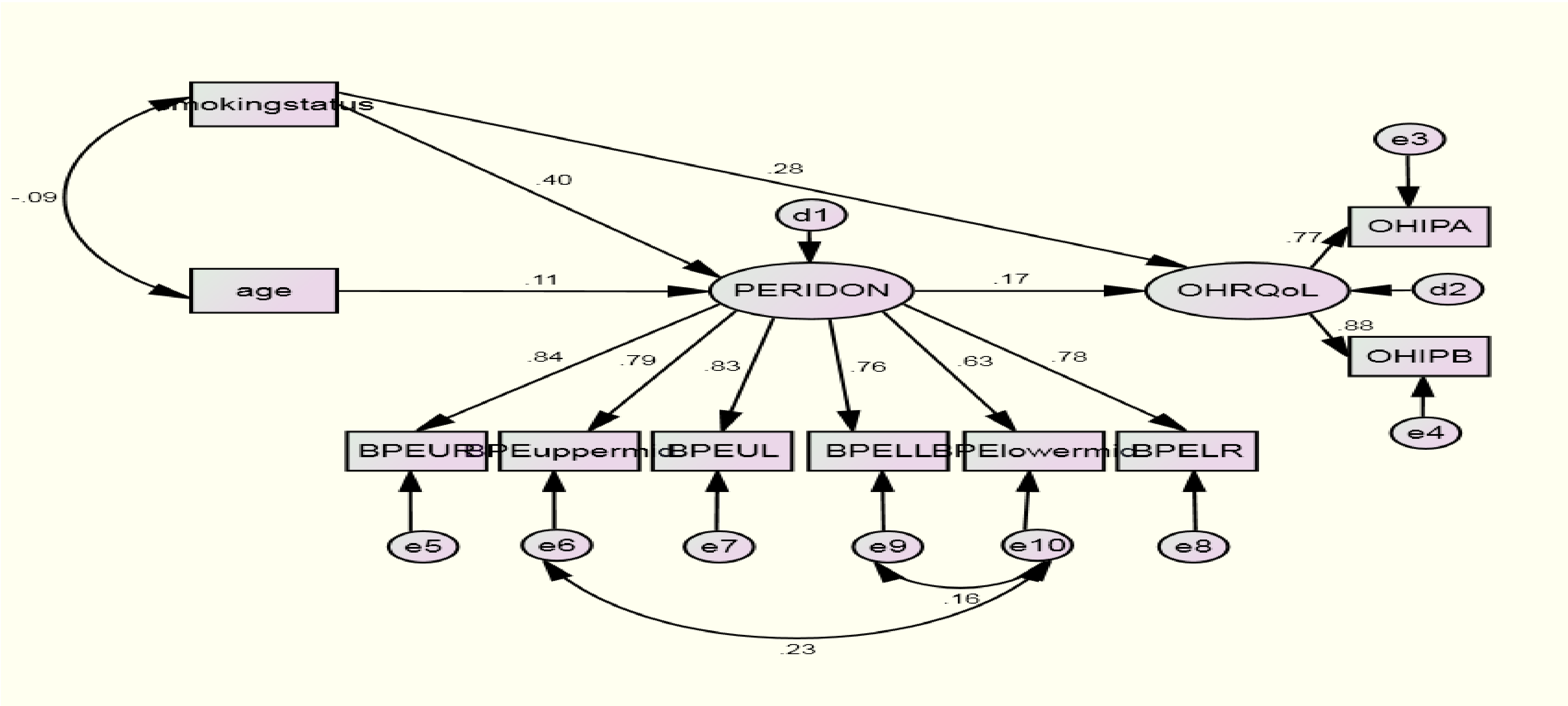
To test whether a simplification to the model could be made, the coefficient between the direct effect of smoking status upon oral health-related quality of life was set to zero. The model was re-estimated and found to be a significantly poorer fit (X^2=17.91, df=1, p=0.0001) demonstrating that the attempt to consider a more parsimonious model without the path being specified between smoking status and oral health-related quality of life (i.e. set to zero) was unsuccessful. Therefore the substantive paths between the variables smoking, periodontal status and quality of life were important to include. Age was included as an essential covariate even though its influence was only moderate to allow explanation of the relationship within the model independent of age.

The estimates of grouping for complexity of periodontal treatment need by occupational group were unreliable due to the small numbers in some groups, including zero. For this reason, occupational group was not included in the final SEM. Location was also omitted as there were not sufficient numbers of participants in Dunoon. To assess that the model was essentially true for both sexes the SEM procedure was run with the two groups (male and female) simultaneously with all paths constrained to be equivalent across groups. The chi square value was small and non-significant (X^2=3.34, df=4, p=0.50) showing the model was acceptable for both genders.

Table 3.35: Correlation matrix of variables included in the SEM analysis

		Oral health-related quality of life	Periodontal status	Smoking status	Age
Oral health-related quality of life	r_p	1	0.25	0.29	-0.036
	p		<0.001	<0.001	0.47
	No.	398	398	397	398
Periodontal status	r_p	0.25	1	0.35	0.29
	p	<0.001		<0.001	<0.001
	No.	398	398	397	398
Smoking status	r_p	0.29	0.35	1	-0.043
	p	<0.001	<0.001		0.39
	No.	397	397	397	397
Age	r_p	-0.036	0.29	-0.043	1
	p	0.47	<0.001	0.39	
	No.	398	398	397	398

Figure 3.10: Structural equation model of smoking status, periodontal health and oral health-related quality of life.



3.5 Discussion

The need to develop a smoking cessation intervention tailored to the needs of primary dental care patients attending and residing in remote-rural areas became apparent as a result of the failure of the PHaSCe trial and the findings of the systematic review which examined the effectiveness of smoking cessation interventions. Therefore the aim of the survey was to model a smoking cessation intervention for primary dental care in remote-rural Scotland. The specific objectives were thus:

1. determine the prevalence and risk factors for chronic periodontitis, and its impact on oral health-related quality of life in a population of registered primary care dental patients in remote-rural Scotland.
2. model a smoking cessation intervention based on smoking status, periodontal health status and oral health-related quality of life collected in a sample of adults attending a general dental practice in a remote-rural area.
3. recommend the characteristics of a feasibility trial for a smoking cessation intervention for primary dental care in remote-rural Scotland

3.5.1 Demography

A convenience non-probability sample was gathered which reflected the demographic characteristics with regard to gender and age of those registered and attending primary dental care practices. Moreover the ethnic profile of the sample reflected the ethnic profile of Argyll & Bute CHP as a whole in which only 0.5% of the population is from ethnic minority groups, mostly from Eastern Europe (Nicoll et al. 2012). The socio-economic position of participants as assessed by the four occupational categories showed similar proportions to those of the population of Argyll & Bute Community Health Partnership (CHP) and Scotland as a whole (Scottish Household Survey 2012). This suggested that the sample population was representative of people in Argyll & Bute CHP.

The medical profile of the respondents suggested that this sample population were healthier than those in the general Scottish population, since they reported less experience of cardiovascular disease, diabetes and respiratory disorders than those of the Scottish population as a whole (Scottish Health Survey 2012). Just over half of the sample reported a greater experience of prescribed medication suggesting they had at least one long-standing illness and receiving regular medical care. This finding was similar for the Scottish population (Scottish Household Survey 2012).

As was to be expected a strong association between socio-economic position and poorer health was reflected in the survey findings with a higher proportions of unskilled workers reporting receiving medical treatment than groups of skilled workers(Scottish Health Survey 2012). The Scottish Household Study explores long-standing illness by household income and found a differential of 36% between those earning under £10,000 per annum and those earning over £40,000 (Scottish Household Survey 2012). Oral diseases, including chronic periodontitis, are found to be more prevalent in lower socio-economic and educational groups than higher ones (Bonfim et al. 2013; Singh et al. 2013; Borrell and Crawford 2012; Bastos et al. 2011; Boillot et al. 2011).

The proportion of smokers in the study sample was directly comparable with that of the Scottish population as a whole – 23.4% and 24.1% respectively. Whilst the demographic profile of participants in Lochgilphead and Dunoon were similar, the proportion of smokers in Dunoon was twice that of Lochgilphead – 38% compared with 19%. This would suggest that the socio-economic profiles of the two samples vary and may reflect the fact that in Lochgilphead the Salaried Dental Practice is the only one available and so serves a cross-section of the general population, whereby in Dunoon there are also two independent dental practices which cater for routine patients. This results in those people who find it more difficult to access routine dental care e.g. those with chaotic lifestyles, migrating to the Salaried Dental Services where they are more easily accommodated than in independent practice. This is further supported by the finding that 50% more patients fail to attend appointments in Dunoon than in Lochgilphead. Despite comparisons of occupational status not demonstrating statistically significant differences overall, the proportion of highly skilled occupations among participants in Dunoon was less than half that in Lochgilphead perhaps indicating that more educated and affluent people are choosing to attend the independent dental practices.

3.5.2 Smoking status

The proportion of smokers in the younger age group is double that in the older age group in the results of this survey (31.7% compared with 15.2%) and this reflects findings elsewhere e.g. in the Scottish population overall in 2012, 27.8% of younger adults were smokers as opposed to 19.8% of older adults (Scottish Health Survey 2012; Scottish Household Survey 2012; Chadwick et al. 2011).

This suggests that as the health impacts of smoking become more apparent with age, so it may be suggested that with increased morbidity older people are more likely to quit smoking tobacco compared with younger people. Moreover, it is possible that health-directed smoking cessation i.e. directly related to their own disease experience, may be more successful than in younger people.

Results from this survey mirrored those from other studies (American Cancer Society 2010; Department of Health 2004; Watt et al. 2000; Peto et al. 1996) in finding a relationship between smoking and medical conditions such as angina, diabetes and hypertension. Smoking status had a significant impact on reported rates of receiving medical treatment and myocardial infarction, with a larger proportion of ex-smokers and current smokers reporting these conditions. These results are to be expected given the negative health impacts of smoking, including on cardiovascular health (American Cancer Society 2007; Department of Health 2004; Watt et al. 2000; Peto et al. 1996). The proportion of current smokers reporting infectious diseases such as hepatitis was very much larger than proportions of never and ex-smokers and this result was highly significant. Nicotine is reported to be a gateway drug and the proportion of smokers found among those misusing injectable substances is very high (Biederman et al. 2012). This link to high risk behaviours may explain the significantly higher proportion of smokers rather than non-smokers in this study reporting infectious diseases. No statistically significant effects were found related to other reported medical conditions.

The knowledge of respondents regarding the health impacts of smoking was assessed by asking them to decide whether smoking was linked to the development of twelve disorders presented in a list. The mean correct score across all disorders was 55%, and few statistically significant differences were found with demographic variables. Notably, however, the proportion of those in unskilled occupations who recorded that smoking was related to lung cancer was significantly lower than for other occupational groups. Smokers were also proportionately more likely to assert that oral and lung cancer were unrelated to smoking when compared with ex-smokers and never smokers and these results reached statistical significance. Other studies have similarly reported that smokers are less aware of the risk of smoking for oral and lung cancer (Terrades et al. 2009; van Schyack et al. 2008; West et al. 2006). In fact, there was a tendency across all diseases for never and ex-smokers to relate smoking with all disorders, whether or not they were smoking related, and for current smokers to fail to recognise the impact of smoking. This would seem to suggest that smokers are unwilling to acknowledge the harm inflicted by smoking whilst many non-smokers are emphatic in their disapproval, and can overestimate its impact (O'Connor et al. 2007; Yong et al. 2005).

A twelve-point attitudinal scale was used to assess smokers' attitudes to their smoking habit and, after undergoing a principle component factor analysis, two scales were described which were conceptualised as 'willingness to quit smoking' and 'confidence to quit smoking'. The results of analysing these two scales by lifetime exposure to nicotine and nicotine dependence showed that neither affected willingness to quit, but the greater the exposure to and dependence on tobacco, the lower the confidence in being able to quit. This suggests that smokers are aware of the extent of their dependency, and this not only negatively affects the strength of physiological nicotine withdrawal symptoms, but also a lack of confidence in succeeding in itself makes a quit attempt less likely (Zhou et al. 2009; Heatherton et al. 1991).

When quit attempts in the previous two months, and readiness to quit in the future, were analysed by the willingness to quit and confidence to quit scales, those who had cut down, tried to quit and stopped for at least 24 hours had greater mean scores than those who had not, showing a strong link between attitudes to quitting and recent quit behaviours (Kowalski et al. 1997).

Predictably, for both the ‘willingness to quit’ and ‘confidence to quit’ scales significantly and progressively lower mean scores were found for those who planned to stop in the next thirty days, those who planned to stop in the next six months, those who planned to quit, but not in the next six months, and those who did not intend to quit. Willingness to quit was found to be low only in those who did not intend to quit, with moderate to high levels of willingness being demonstrated in all other stages of readiness to quit. Only those smokers who had set a quit date in the next thirty days showed significantly more confidence than those at other stages of readiness to quit. This contrasts with the findings of McEwen et al. (2006) whose respondents had high levels of confidence they could quit, although no significant relationship was found between confidence and actual quit rates. However, Manfredi et al. (2006) found a significant link between confidence and quit success in a group of women of low socio-economic status.

These results suggest that the attitudinal scales could be used to indicate whether a reluctance to make a quit attempt is due to a lack of willingness or a lack of confidence. This can then be used to inform the development of an individualised stop smoking intervention truly reflecting the needs of the individual smoker. The focus should shift towards providing interventions tailored to increasing the willingness and confidence of individuals in their ability to quit where this is found to be lacking.

Smokers who participated in the survey used cigarettes (66%) or roll-ups (41%) with no-one reporting use of smokeless tobacco. This confirms that the results of the randomised controlled trials examining the effectiveness of tobacco-related cessation interventions found in the systematic literature review and which dealt with smokeless tobacco are not immediately transferable to this population (Walsh et al. 2010; Gansky et al. 2005; Walsh et al. 2003; Gansky et al. 2002; Walsh et al. 1999).

Only two participants (0.5% of the sample) reported using cannabis as compared with 3.6% of respondents in the Scottish Crime Survey reporting use of cannabis in the previous month (Scottish Crime & Justice Survey 2010). This may result from a reluctance to admit using an illegal substance even in an anonymous questionnaire, but may partly be explained by the design of the questionnaire. Only smokers completed the second part of the questionnaire and there may be cannabis users who do not consider themselves to be smokers and so did not proceed far enough in the questionnaire to be asked the question.

Mean pack-years, which represent lifetime exposure to tobacco, were significantly higher in the older age group as would be expected, and the proportion of males who were heavier smokers was significantly higher than the proportion of females. The Scottish Health Survey also found that, on average, men were heavier smokers than women (Scottish Health Survey 2012). Males were also found to have significantly higher levels of nicotine dependence in this trial. The mean level of nicotine dependence encountered in this study sample – 3.9 – was lower then that in a sample population drawn from patients attending a Scottish secondary care establishment for treatment of periodontal disease in which a mean nicotine dependence of 5.0 was found despite a lower overall exposure to tobacco – mean life pack years of 26.3 in the study sample compared with 21.5 in the study undertaken in secondary care (Binnie et al. 2007). This may be explained by the higher degree of treatment need in periodontal patients attending for specialist care compared with those accessing routine treatment in primary care. Two studies undertaken among hospital inpatients also found higher levels of nicotine dependence than in this study – 5.0 (Molyneux et al. 2003) and 6.0 (Gritz et al. 1991). A postal questionnaire survey conducted by Martinelli et al. (2008) found a mean nicotine dependence of 3.5 which is similar to the current study score of 3.9.

Sixty three percent of the study sample reported that they seriously intended to quit in the coming six months compared with 73% in the Scottish Health Survey (2012). It is unclear why this discrepancy should exist. Despite the high proportion of smokers in the Scottish Health Survey (2012) reporting that they wished to quit, only 38% reported ever having tried. This implies that even for those smokers who wish to quit, this only translates into a quit attempt in around half of cases. Reported quit behaviour in the previous six months in the study sample showed 24% reporting they had tried to quit smoking. Only 20% indicated that they had no intention of ever quitting, a significantly higher proportion of whom were in the older age group. This correlates with the results of the Scottish Health Survey 2012 which also found the lowest desire to quit in the older age group. This may reflect failed quit attempts in the past or entrenched habits not easily amenable to change (Ryckman et al. 2009; Roddy et al. 2006; Yong et al. 2005). Older people have been shown to be less easily persuaded of the negative health impacts of smoking, especially if they are long-term smokers who have not experienced smoking-related ill health (Wakeman et al. 1996). However, older smokers who experience ill-health are likely to want to quit, and to succeed in their quit attempt (Sachs-Ericsson et al. 2009). Paradoxically, Schofield et al. (2006) found some older people claiming that smoking cessation could further prejudice their health.

In a study exploring the feasibility of introducing smoking cessation interventions in secondary care in Scotland, only 10% of the participants reported having no intention of quitting in the future, compared with 20% of the study population (Binnie et al. 2007). It may be postulated that as these participants had already committed to attending for specialist care they may more highly motivated than the general population of smokers attending primary care facilities. However, as a high proportion of the study population report never intending to quit, and a comparatively low proportion report wishing to quit, this cadre of dental patients may actually be less inclined to quit their smoking habit than the Scottish population at large.

With respect to attitudes to dentists' involvement in smoking cessation activities, there was a high level of support from all participants with 80% agreeing that dentists should ask patients if they smoke, 73% agreeing that they should offer stop smoking advice and 63% agreeing that they should offer counselling support and nicotine replacement therapy. (Campbell et al. 1999) Despite the high level of support, smokers were significantly less agreeable to smoking cessation activities in the dental surgery than ex-smokers and non-smokers which may indicate a degree of unease about discussing the topic which has also been found in other studies (Roddy et al. 2006).

Individuals in the younger age group of the sample reported that their dentists had enquired about their smoking status and offered cessation support significantly more frequently than older individuals. Dentists may feel less intimidated raising the issue of smoking with less mature patients, or may assume that older smokers are not interested in quitting smoking or would accrue less benefit from doing so which is not the case (Phillips 2012; Doolan et al. 2008).

3.5.3 Oral health-related quality of life

The study questionnaire explored participants oral health-related quality of life and results showed that the most common impacts were pain and physical discomfort closely followed by psychological distress: 29.4% and 28.4% respectively as opposed to 30% and 19% in the ADHS 2009 (Nuttall et al. 2011). Sixty eight percent of the sample had experienced at least one impact of oral health-related quality of life in the previous twelve months, and the average total score was 4.4. Overall the population in the current study reported more frequent, but less severe, impacts on daily living as opposed to that in the ADHS (Nuttall et al. 2011). Strikingly, 4.8% of the study population experienced a total inability to function at some point in the previous year showing that oral health can affect quality of life substantially.

Psychological impacts on quality of life were experienced significantly more frequently by younger participants, by females and by those in unskilled occupations, findings also encountered in other studies (Locker and Quinonez 2011; Nuttall et al. 2011; Sanders et al. 2009). Experience of pain and discomfort varied significantly with age, occupational group and location with younger people, unskilled workers and residents of Dunoon being significantly more affected.

Smoking status had a significant impact on quality of life in this population, with all measures except pronouncing words adversely affecting smokers more than ex-smokers and never smokers. The very strong relationship found between smoking and poor oral health-related quality of life could be used to encourage both dental professionals to offer smoking cessation support and to motivate smokers to quit.

The complexity of periodontal treatment needs of this study population was related to oral health-related quality of life with all but two of the OHIP-14 categories showing significant results. Other studies have also found this link (Bernabe and Marcenes 2010; Jowett et al. 2009; Needleman et al. 2004).

Fewer than half of the population reported that things had been going their way recently, and this pessimistic attitude would tend to inhibit smokers from having the confidence to make a quit attempt.

3.5.4 Oral health behaviours

Dental attendance was found to be significantly less frequent among smokers than ex-smokers and never smokers and this replicates findings in other populations (Csikar et al. 2013; Millar and Locker 2007). Smokers were more likely to have last attended for emergency rather than for routine care, as were residents of Dunoon. Conversely, those with professional occupations were significantly less likely to report requiring emergency care (Csikar et al. 2013).

Daily toothbrushing was reported by all participants in this trial with 20% brushing once daily, 70% twice daily and the remaining 10% brushing more than twice daily. These results are very similar to those found in the ADHS which found 23% reporting brushing once daily and 75% brushing twice a day. Males constituted a higher proportion of those brushing only once daily than females as has been found in other studies (Chadwick et al. 2011; Bertea et al. 2007).

Disappointingly, almost half of the participants reported they did not use interdental aids to improve their oral hygiene, however 32% of the study population reported using dental floss as compared with 21% in the ADHS 2009 (Chadwick et al. 2011). As in the ADHS (2009) a significantly higher proportion of females than males reported using interdental aids. As the study population comprised regular dental attenders it would be anticipated that they would have better oral hygiene practices than the general population. A further 19% of the study population reported using interdental brushes compared with 6% of the ADHS 2009 population (Chadwick et al. 2011).

3.5.5 Periodontal status

The participants in this survey were divided into three groups according to the complexity of their periodontal treatment needs as measured by the Basic Periodontal Examination (British Society of Periodontology 2011). The results show that the periodontal need of this study population is higher than that in the Adult Dental Health Survey 2009 (White et al. 2011) – 83.2% compared with 92% in the lowest treatment need group, 12.1% compared with 7% in the moderate treatment need group and 4.8% compared with 1% in the highest complexity of treatment need group. However, the report of the ADHS (2009) suggests that their results underestimate the true level of periodontal treatment need in the population studied (White et al. 2011).

A significantly higher proportion of older participants, and male participants, were found in the most complex periodontal treatment need group, results which replicate those of the ADHS 2009 (White et al. 2011). As periodontal health deteriorates with age, this result is to be expected. The gender difference reflects the higher level of nicotine exposure and lower dental attendance reported by males. Unskilled and semi-skilled workers were also disproportionately found in the group with the most severe periodontal treatment needs, as were those residing in Dunoon. Twelve percent of smokers were found in the severe complexity of periodontal need group as opposed to 1% of never smokers, demonstrating a highly significant finding similar to results found by Klinge and Norlund (2005). This reflects the findings in the ADHS that 15% of current smokers compared with 8% of never smokers had severe periodontal treatment needs (Chadwick et al. 2011).

A significant dose response was encountered when comparing mean pack years with complexity of periodontal treatment need, and those with the lowest nicotine dependence were significantly more likely to be in the group with lowest complexity of treatment need as found in previous studies (Martinelli et al. 2008; Binnie et al. 2007; Molyneux et al. 2003).

Those with the lowest complexity of periodontal treatment need were significantly more in favour of dental professionals offering smoking cessation than those with moderate or high treatment needs who stood to benefit most from smoking cessation. Perhaps smokers with poor periodontal health interpreted advice and support from dental professionals regarding their smoking as being chastised for their habit and were therefore more cautious about receiving it.

Unexpectedly, neither “willingness to quit” nor “confidence to quit” was significantly related to the level of periodontal treatment need experienced by participants. This implies that individuals are either unaware of their periodontal status, which, as these participants were regular dental attenders should not be the case, or they do not value good periodontal health enough to factor it into a decision to quit smoking. Similarly, Rosseel et al. (2010) found that the presence of oral conditions did not influence quit intentions among smokers.

By contrast, increasing complexity of periodontal treatment need demonstrated a strong negative relationship with oral health-related quality of life for all reported impacts barring ‘ability to undertake normal tasks’ and ‘finding life less satisfying due to oral health problems’. This indicates that while participants did not recognise poor periodontal health as serious enough to warrant an attempt to quit smoking, it did have a detrimental effect on their oral health-related quality of life. It may therefore be the case that the messages being delivered by dental care professionals encouraging smoking cessation in order to improve periodontal status have limited impact on an individual’s readiness to quit. Whilst it is incumbent on an oral health practitioner to inform patients of the oral health risks associated with smoking, it may be that delivery of messages relating to the improved general and oral health-related quality of life found amongst non-smokers and ex-smokers would be more successful in motivating patients to make a quit attempt.

Whilst there was no correlation found between overall dental attendance and complexity of periodontal treatment need, those who had last attended for emergency care had significantly higher complexity of periodontal treatment need than those attending for routine care. This suggests that periodontal disease leads to an increased likelihood of experiencing oral pain and discomfort.

Oral hygiene measures such as toothbrushing and interdental cleaning disrupts the dental biofilm and prevents its developing to the point where periodontal disease occurs. For this reason the oral hygiene behaviours of the study population were explored. In this population reported oral hygiene measures were not significantly related to complexity of periodontal treatment need contrasting with the ADHS 2009 (White et al. 2011) which found that increased toothbrushing frequency resulted in lower periodontal treatment needs. Whilst this result is surprising, chronic periodontitis results from the interplay of a myriad of risk factors of which plaque is just one. As participants in this study are regular dental attenders they would have been aware of the recommended frequency of toothbrushing and use of interdental aids and so they may have reported what they thought to be the correct answer, or what they did on a good day, rather than their usual oral hygiene routine, thus downplaying the link between plaque control and periodontal health.

3.5.6 Modelling a smoking cessation intervention for primary dental care in remote-rural Scotland

A model for smoking cessation intervention based on smoking status, periodontal health status and oral health-related quality of life was developed using structural equation modelling and the path analysis model was constructed by interpreting previous findings from the literature and the findings of the survey. This statistical modelling procedure demonstrated the direct relationship between smoking and oral health-related quality of life as well as an indirect effect via periodontal status. The implications of the indirect link of smoking on oral health related quality of life via periodontal status are as follows. First, since smoking affects oral health-related quality of life (greater impacts) it is possible that addressing oral health-related quality of life impacts via periodontal health will assist people to quit smoking. The provision of appropriate periodontal care as part of a smoking cessation intervention in remote-rural primary dental care may improve people's quality of life. It is suggested therefore that it is by focusing on quality of life and employing periodontal treatment strategies that smokers could be encouraged to quit smoking tobacco, the outcome being improved oral health-related quality of life.

3.5.7 Limitations

As a nonprobability convenience sample was gathered it is possible that this was not representative of the population however when the demographic profile of the sample was compared to that of Argyll and Bute it seemed to be characteristic of that population. The smoking status of participants in the survey was collected by self-report only with no biochemical verification. This may have resulted in an underestimation of smoking intensity, however previous research has shown a good correlation between self-report and biochemical validation for smoking status (Brugger 2013). Therefore with regard to smoking status it is acknowledged that the use of a nonprobability convenience sample means that caution is required in generalising these findings.

3.6 Conclusions

The high degree of agreement with dentists' involvement with smoking cessation activities suggests that dentistry has the potential to make a significant contribution to smoking cessation in remote-rural areas. Oral health-related quality of life showed significant differences between categories of both periodontal health status and smoking status. It would seem therefore that focusing on oral health-related quality of life as a primary outcome in dental-based smoking cessation interventions rather than periodontal outcomes could provide a promising means of promoting both oral and general health.

Chapter 4: Overall Discussion & Conclusions

4.0 Introduction

This thesis represents an adventurous journey through smoking cessation interventions in remote-rural primary dental care in Argyll and Bute Community Health Partnership in Scotland. It is also represents a learning experience in which the importance of accessing the evidence-base to support an intervention together with understanding the specific elements of an intervention have been realised. Therefore the initial aim of this thesis was to determine the amount of additional benefit for the promotion of periodontal health in a remote-rural population, achieved by comparing an intensive smoking cessation intervention provided by a dental therapist in the dental surgery, with an intensive smoking cessation intervention provided by an NHS smoking cessation specialist outwith a dental setting, but it became clear that a 'top-down' approach was inappropriate.

4.1 Recruitment

The PHaSCe trial with its the low number of participants recruited made it impossible to answer the research question of whether there is an additional benefit for the promotion of periodontal health in a remote and rural population achieved by an intensive smoking cessation intervention provided by a dental therapist in the dental surgery compared with an intensive smoking cessation intervention provided by an NHS Smoking Cessation Counsellor in a non-dental setting. Some of the issues involved in the poor recruitment rates were undoubtedly the constraints applied by the Research Ethics Committee and the study design which combined to result in participants attending four separate appointments prior to commencing the smoking cessation intervention.

4.2 Quit rates and power calculations

Evidence from research papers indicates that around 70% of smokers would like to quit (Scottish Health Survey 2012; van Schyack et al. 2008), however results of the survey conducted in this project showed that only 56% of this study population wished to quit in the next six months. A further 8% had set a quit date. This compared with 46% contemplating giving up in the next 6 months and 24% preparing to quit in the next 30 days in a postal questionnaire conducted by Martinelli et al. in 2008. It would appear therefore that fewer of this population of smokers are ready to quit than in other groups of smokers and the Scottish population as a whole. As quit rates among those supported by pharmacological and behavioural support average 15%, the actual numbers of participants required in both the control and intervention groups to demonstrate a difference with 80% power in periodontal health would have required a sample of 434. This would have rendered the randomised controlled trial impracticable at this stage and would have indicated that a multi-centre trial would be required to answer the research question.

4.3 Recommendations

Therefore, the MRC Framework for Complex Interventions (2010), facilitated a reconsideration of what steps needed to be put in place to permit the modelling of a smoking cessation intervention for remote-rural primary dental care in Scotland. It was necessary to revisit the evidence-based literature regarding the effectiveness of smoking cessation interventions in remote-rural localities. A systematic literature review demonstrated that little research into the effectiveness of smoking cessation interventions in remote-rural areas had been conducted, and that the number of randomised controlled trials investigating the effectiveness of smoking cessation interventions in a dental setting was negligible. Moreover the randomised controlled trials had focused on specific target populations of young men who used smokeless rather than smoked tobacco. Therefore their relevance to primary care dental patients in remote-rural Scotland was limited (Walsh et al. 2010; Gansky et al. 2005; Walsh et al. 2003; Gansky et al. 2002; Walsh et al. 1999). The need for further research and the modelling of an intervention for patients attending remote-rural primary dental care was necessary.

In this regard, a survey to examine prevalence of smoking, periodontal health together with smoking-related knowledge, attitudes (including oral health-related quality of life) and behaviours was undertaken. This allowed the modelling of a intervention based upon a path analysis from the information gleaned in the systematic review and the survey. It suggested that a smoking cessation intervention for remote-rural primary dental care should focus on quality of life and employ periodontal treatment strategies to encourage smokers to quit smoking tobacco. The primary outcome being improved oral health-related quality of life and secondary outcome improved periodontal health status.

4.4 Conclusions

In conclusion, following the lack of success of the PHaSCe trial, the information collected from the systematic literature review and the smoking and periodontal health prevalence survey permitted the modelling of a smoking cessation intervention for remote-rural primary dental care based on oral health-related quality of life and periodontal disease. Thus a feasibility trial should incorporate quality of life as the primary outcome measure to assist in answering a reformulated research question:

'What is the additional benefit of,

an intensive smoking cessation intervention provided by a dental therapist in the dental surgery,

Compared with,

an intensive smoking cessation intervention provided by an NHS smoking cessation specialist outwith a dental setting,

For,

the promotion of quality of life and periodontal health status

For,

a population of patients attending remote-rural primary dental care?

Chapter 5: Recommendations

It is recommended that a feasibility trial of a smoking cessation intervention be conducted based on the evidence gathered in this research project such that the intervention:

- Emphasises patient-centred health gains i.e. quality of life benefits rather than biomedical gains such as reduced pocket depths
- Incorporates the attitudes questionnaire used in the prevalence study to assess the individual smoker's willingness and confidence to quit which will then inform the behavioural support provided
- Provides pharmacological support according to the smoker's preference and in accordance with the evidence base available
- Ensures dental professionals have sufficient training, knowledge and motivation to integrate the smoking cessation intervention into their routine dental care

The results of the feasibility trial would subsequently be utilised to model a multi-centre trial which would have sufficient power to determine whether there is an additional benefit for the promotion of periodontal health in a remote and rural population, achieved by comparing an intensive smoking cessation intervention provided by a dental therapist in the dental surgery, with an intensive smoking cessation intervention provided by an NHS smoking cessation specialist outwith a dental setting.

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Appendices

Appendix 1: Behaviour change theories

Several theories of behavioural change have been described in an attempt to understand the factors required to elicit change away from detrimental health behaviours. Using a theoretically-based behaviour change model allows development of interventions designed to encourage individuals to adopt and maintain healthy choices (Family Health International, 2007). There follows a description of the commonly cited theories and models of health behaviour changes relating to addictions.

<u>Theory of Planned Behaviour</u>
The Theory of Planned Behaviour postulates that behaviour change occurs as a result of behavioural intentions and perceived behavioural control. In this model behavioural intentions comprise attitude to how favourable the behaviour change is felt to be, and the subjective norms of those people important to the individual i.e. the individual's perception of what respected others actually do, as opposed to what they think they should do. Perceived behavioural control is a concept similar to self-efficacy, describing the extent to which the individual feels able to adopt a new behaviour (Ajzen, I. 1985). However, it has not been used to develop interventions, but only to explain behaviour change which has already taken place (Webb et al, 2010).

<u>Health Belief Model</u>
The Health Belief Model aims to predict the likelihood of a beneficial health behaviour being adopted using the following four predictors:

- Perceived susceptibility to and severity of the disease protected against;
- Perceived effectiveness of the preventive behaviour
- Perceived barriers to behaviour change
- Cues to action e.g. health warnings on cigarette packets

This model was designed to explain lack of participation in large public health interventions. Literature reviews have shown that perceived barriers have the strongest predictive value for acceptance of behaviour change (Janz & Becker, 1984). It has been used to explain participation in smoking cessation programmes amongst other public health measures but only using part of the model rather than the model in its entirety.

Manfredi et al. (2006) developed a theoretical path model of smoking cessation based on the health belief model which considered the impact and interrelationship of various factors on future quit attempts. These included background factors such as race and education, mediating factors such as stress, health concerns and social pressure to quit, and precursors of quitting smoking such as situational self-efficacy, confidence and motivation and their relationship to recent cutting down or quitting actions and future quitting plans.

<u>Transtheoretical (Stages of Change) Model</u>

Described by Prochaska and DiClemente (1982), the Transtheoretical, or Stages of Change Model, is based on a combination of psychotherapy models. It aims to assess an individual's readiness to change to a healthier behaviour and provide them with strategies to do so. Many stop smoking counsellors are trained to use the Stages of Change component of the transtheoretical model in delivering counselling to their clients and this describes six stages of change:
Precontemplation – person has no intention of changing in the foreseeable future;
Contemplation – person is intending to change in the next six months;
Preparation – person is intending to change in the immediate future, often described as in the next month;
Action – person has made changes in their behaviour at some point in the previous six months;
Maintenance – the person is actively avoiding return to the adverse behaviour;
Termination – the person is free from temptation and is confident they will never return to the adverse behaviour.

The model states that interventions should be tailored to the stage of change of the individual and aim to move them through the six stages. Cognitive, affective and evaluative processes should be employed in the early stages moving on to use of commitments, conditioning, contingencies and environmental controls in the later stages (Prochaska et al, 2008).

Motivational Interviewing

Motivational interviewing employs the use of open questions when interviewing a client in order that they relate their own beliefs and attitudes to their behaviour, as many people have mixed feelings towards giving up a behaviour they may have depended on for many years. Motivational interviewing helps them to resolve these ambivalent attitudes in a supportive environment in which the counsellor commits to assisting in the preparation for their quit attempt (Rubak et al, 2005). They are then encouraged to identify strategies for implementing change and coping with temptation from their own prior experience and knowledge of their strengths and weaknesses (van Schayck, 2008).

The PRIME theory

West (2006) developed a synthetic model of motivation in an attempt to combine elements of all the above theories into a comprehensive model which could inform interventions for addictive behaviours. The PRIME theory – Plans, Responses, Impulses, Motives and Evaluations – West developed indicates that an individual makes decisions to satisfy their needs of the moment, not for the long-term. A change in behaviour will result from a person wanting or needing to change and when they can form an image of the pleasure, satisfaction or relief this will afford them. Thus a smoker who feels they ought to stop smoking is highly unlikely to succeed whereby one who wants or needs to has a much higher possibility of success. This model also states that self-control is essential to changing behaviour and that this is a function of deliberate plans to change combined with a change in identity e.g. recent quitters who consider themselves to be non-smokers and believe they will never again smoke are much less likely to relapse. West believes that the behavioural support element of a smoking cessation intervention should focus on developing a new identity for the quitter as a non-smoker, thus a sudden cessation of smoking on a quit date with strong rules that not even a puff can be taken after that date will reinforce this revised identity (West, 2009).

Cut down to quit

In contrast, a model whereby smokers decrease the number of cigarettes they smoke while receiving NRT as a prelude to giving up completely is known as "cut down to quit". Its success rate has proved to be intermediate between no use of NRT and complete abstinence with NRT and behavioural support, and so it can be offered to those smokers who do not feel able to quit completely (Wang et al, 2008). The evidence base for this model is not as strong as for complete cessation and there is no safe level of smoking, so this model should only be offered when conventional stop smoking support has failed.

The above theoretical models share the belief that self-efficacy is required to enable positive behaviour change and its maintenance. To a greater or lesser extent, they recognise the importance of environmental and societal norms of an individual's circumstances in shaping their motivation and capacity to adopt new behaviours. Each model had been applied to stop smoking interventions, with the Stages of Change Model most commonly cited.

Despite its widespread use, the Stages of Change model is controversial with critics who point out that the stages are not mutually exclusive, and individuals rarely proceed in this rational and sequential manner through the stages (West, 2005). A randomised controlled trial conducted in 2009 did not find that the Stages of Change model was more successful than one that did not involve staging in promoting smoking cessation (Aveyard et al, 2009).

Motivational interviewing is gaining support in smoking cessation services and its use is becoming more prevalent. The effectiveness of motivational interviewing in smoking cessation interventions has been demonstrated experimentally (Soria, 2006).

Appendix 2: The dental health and smoking habits questionnaire, Version 1.3, 22/05/12

PHaSCe

Periodontal Health and Smoking Cessation

Dental Health
and
Smoking Habits Questionnaire

Dental Health and Smoking Participant Self-Completion Questionnaire, Version 1.3, 22/05/12

Participant number: □□□□□ Date of Birth: □□/□□/□□

Confidential medical history	Yes	No	Don't know	Prefer not to say
Are you receiving treatment from a doctor, hospital, clinic or specialist?				
Are you taking any medicines, pills, syrups, ointments, puffers or injectors prescribed for you by the doctor? If yes, please list:				
Have you had angina?				
Have you had blood pressure problems?				
Have you ever had a heart attack?				
Do you suffer from any infectious diseases, e.g. HIV, hepatitis?				
Do you have asthma or any other lung disease?				
Do you have epilepsy?				
Do you have diabetes?				
Do you bruise or bleed easily?				
Are you allergic to any medicine, foods or materials?				
Are you pregnant?				
Are there any other details you feel we should know about your medical history?				

Gender: ☐ Male ☐ Female
Ethnic origin: ☐ White ☐ African/Caribbean

☐ Asian ☐ Gypsy/traveller ☐ Other _________

First language (if not English): ______________________________

Occupation or previous occupation: ___________________________

In the last 12 months:	**Never**	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**
Have you ever had trouble pronouncing any words because of problems with your teeth, mouth or dentures?					
Have you felt your sense of taste has worsened because of problems with your teeth, mouth or dentures?					
Have you had painful aching in your mouth?					
Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?					
Have you been self-conscious because of your teeth, mouth or dentures?					
Have you felt tense because of problems with your teeth, mouth or dentures?					
Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?					
Have you had to interrupt meals because of problems with your teeth, mouth or dentures?					
Have you found it difficult to relax because of problems with your teeth, mouth or dentures?					
Have you been a bit embarrassed because of your teeth, mouth or dentures?					
Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?					
Have you had difficulties doing your usual jobs because of problems with your teeth, mouth or dentures?					
Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?					
Have you been totally unable to function because of problems with your teeth, mouth or dentures?					

Dental history

Have you been to the dentist in the last year?

☐ Yes ☐ No

What made you go to the dentist last time you went?

☐ Check up ☐ Trouble with teeth ☐ Other _______________

How often do you brush your teeth?

☐ Once per day ☐ Twice per day ☐ Other _______________

How do you clean between your teeth?

☐ Toothbrush only ☐ Dental floss ☐ Dental tape

☐ TePe brushes ☐ Woodsticks ☐ Toothpicks

Please complete the section below by ticking the box which most closely describes how you feel with 1 indicating you definitely agree and 5 indicating you definitely do not agree

	Definitely agree	Agree	Neither agree nor disagree	Disagree	Definitely disagree
How much do you agree that dentists should ask their patients if they smoke?					
How much do you agree that dental staff should offer advice about quitting smoking?					
How useful do you think it would be if dental staff could provide counselling to help smokers to quit?					
How useful do you think it would be if dental staff could provide nicotine replacement therapy to help smokers to quit?					

Please tick the boxes below to show whether you think the following health problems can be caused by smoking cigarettes:

Arthritis	☐	Yes	☐	No	☐	Don't know
Heart disease	☐	Yes	☐	No	☐	Don't know
Gum disease	☐	Yes	☐	No	☐	Don't know
Skin disease	☐	Yes	☐	No	☐	Don't know
Broken arm	☐	Yes	☐	No	☐	Don't know
High blood pressure	☐	Yes	☐	No	☐	Don't know
Mouth cancer	☐	Yes	☐	No	☐	Don't know
Lung cancer	☐	Yes	☐	No	☐	Don't know
Toothache	☐	Yes	☐	No	☐	Don't know
Dementia	☐	Yes	☐	No	☐	Don't know
Bronchitis	☐	Yes	☐	No	☐	Don't know
Liver disease	☐	Yes	☐	No	☐	Don't know

Are you a: smoker	☐	Smoker	☐	Ex-smoker	☐	Never

If an ex-smoker how long ago did you give up: ______________________________

The rest of the questions are for smokers only, so if you do not smoke please stop here and thank you for completing the questionnaire. Smokers please continue to the end.

Smoking habits

How soon after you wake up do you smoke your first cigarette?

☐ Less than 5 minutes ☐ 6–30 minutes ☐ 31–60 minutes ☐ over 60 minutes

Do you wake during the night to smoke a cigarette? ☐ Yes ☐ No

Do you smoke most frequently in the morning? ☐ Yes ☐ No

Do you smoke if you are ill enough to spend most of the day in bed?

☐ Yes ☐ No

Which of the following tobacco products do you use?

☐ Roll-ups ☐ Pipe ☐ Cigars ☐ Snuff

☐ Chewing tobacco ☐ Cannabis ☐ Cigarettes

Which cigarette would you find it hardest to give up?

☐ First one in the morning ☐ After a meal ☐ Other ________________________

How old were you when you started smoking? ___________________________years

How many cigarettes or roll-ups do you smoke per day?

☐ 10 or less ☐ 11-20 ☐ 21-30 ☐ over 30 ☐ not sure

If you smoke roll-ups, please state the quantity of tobacco you use per day: _____

How many other smokers live in your house?

☐ none ☐ 1 ☐ 2 ☐ 3 ☐ 4 or over

Please complete the section below by ticking the box which most closely describes how you feel with 1 indicating not at all and 5 indicating very much

	Not at all 1	A little bit 2	Neither/nor 3	Somewhat 4	Very much 5
I am concerned about the effects of smoking on my health					
I am concerned about the effects of smoking on other people around me					
People close to me want me to quit smoking					
I am confident in dealing with my personal problems					
I feel that things have generally gone my way this last month					
I want to cut down on my smoking					
I want to quit smoking					
I intend to quit smoking					
I am confident that I could refrain from smoking when I am angry					
I am confident that I could refrain from smoking when I am under pressure					
I am confident that I could cut down on my smoking					
I am confident that I could quit smoking all together					

In the past 2 months have you:

Cut down the number of cigarettes that you smoke? ☐ Yes ☐ No

Tried to quit smoking? ☐ Yes ☐ No

Stopped smoking for at least 24 hours? ☐ Yes ☐ No

Which of the following statements best describes your plans to quit smoking?

☐ Don't plan to stop

☐ Don't plan to stop in next 6 months

☐ Seriously considering quitting in next 6 months

☐ Have set a date to quit within the next 30 days

Have you ever been asked by your dentist whether you smoke?

☐ Yes ☐ No

Have you ever been offered advice by your dentist or dental staff about quitting smoking?

☐ Yes ☐ No

Has anyone at your dental practice ever offered to refer you to smoking cessation services?

☐ Yes ☐ No

Has anyone at your dental practice ever given you information about how to contact them?

☐ Yes ☐ No

THANK YOU

NHS
Highland

Appendix 3: Pilot study of characteristics of semi-quantitative salivary cotinine tests

Characteristics of the tests

SmokeScreen Saliva (GFC Diagnostics) employs a cotton swab to collect unstimulated saliva from the floor of the mouth which is then squeezed into a sample collector. A 1ml sample is removed using a syringe and this is deposited into the Smokescreen test tube. The saliva and chemicals are agitated for five seconds and the test tube stored upright for ten minutes when the results are ready. The SmokeScreen test is a colorimetric assay whereby the pyridine ring structure of nicotine and its metabolites is broken down leaving it available for attachment by the condensing agent. No change of colour or a change to brown indicates a negative result and therefore no exposure to nicotine. A change of colour to pink indicates that nicotine is present and the depth of colour indicates light, medium or heavy exposure. Intermediate colour changes can be classed as light to medium or medium to heavy exposure.

SmokeScreen Saliva was found in a comparison with laboratory gas chromatography to have a sensitivity of 89% and a specificity of 94% (Cope et al, 2000). It has proven to be successful in encouraging those who are quitting smoking to continue with their quit attempt by demonstrating the drop in cotinine levels when smoking stopped (Barnfather et al, 2005).

NicAlert Saliva (Nymox Pharmaceutical Corporation) uses a test strip impregnated with antibody-coated gold particles and a series of avidity traps allowing quantification. The distance that the gold migrates along the test strip gives an accurate measure of the amount of cotinine in the sample. The saliva is collected by spitting into a plastic tube via a funnel. Once the tube is half full the funnel is discarded and a plastic cap incorporating a dropper is placed over the end. Eight drops of saliva are deposited on the padded end of the strip which is left for 20-30 minutes (until a blue indicator strip disappears) and the result can be read. There are 7 numerical bands on the test strip which correspond to different levels of cotinine present as follows:

0	0-10 ng/mL
1	10-30 ng/mL
2	30-100 ng/mL
3	100-200 ng/mL
4	200-500 ng/mL
5	500 – 1000 ng/mL
6	Over 1000 ng/mL

Several papers have been published comparing the results of NicAlert with laboratory gas chromatography/mass spectrometry, although most have used urine rather than saliva (Bernert et al, 2005, Gariti et al, 2002, Parker et al, 2002). These have shown an average sensitivity of 96% and specificity of 94%.

NicAlert Saliva was found to have a sensitivity of 99% and a specificity of 96% compared with liquid chromatography/mass spectrometry (Montalto & Wells, 2007). Cooke et al, 2008 used gas chraomatography/mass spectrometry as their gold standard and found NicAlert Saliva to have a sensitivity of 93% and a specificity of 95%.

Method

The two kits were tested using samples from eight individuals who provided two saliva samples and completed a questionnaire regarding their smoking history at the same visit. The age range of the people taking part was from 25 – 63 years, and three were male and five female. Three of the participants were non-smokers, and of the five smokers the number of cigarettes smoked per day ranged from 10 – 30. The results from the two tests were compared and the acceptability of the two methods of saliva collection was rated by each participant.

Results

Cotinine levels as per tests

No.	Smoking History	SmokeScreen Result	NicAlert Result
1	Never smoker, In smoky atmosphere previous evening	No colour change	Level 1
2	Long term ex-smoker	No colour change	Level 0
3	Approx. 10 cigs/day	Light smoker	Level 3
4	Approx. 15 cigs/day	Moderate - heavy	Level 4
5	Approx. 20 cigs/day	Moderate	Level 4
6	15-20 cigs/day	Moderate	Level 3
7	Never smoker	No colour change	Level 0
8	Approx. 10 cigs/day	No change of colour	Level 2

Acceptability of tests to participants

SmokeScreen Saliva

Not acceptable	0	Tolerable	1	Moderately acceptable	2	Very acceptable	5

NicAlert Saliva

Not acceptable	0	Tolerable	0	Moderately acceptable	4	Very acceptable	4

Conclusions

The results above indicate that the NicAlert test is more sensitive than the SmokeScreen test as it detected exposure to second hand smoke in a non-smoker, while the SmokeScreen failed to identify a smoker of 10 cigarettes per day.

Differences in the level of cotinine detected were found in both tests for smokers claiming to smoke similar amounts. This may indicate that one of these smokers inhales more deeply than the other, rather than any error in detection.

Participants found both tests acceptable, with very little difference between the two.

The operator found the NicAlert test easier to use. Six of the eight participants found it difficult to collect enough saliva with the SmokeScreen swab, and required several attempts. The actual process for both tests are easily understood and undertaken but again, the operator found the results easier to read on the NicAlert test strip as it gave a numerical result. A disadvantage of the NicAlert test is that it takes 30 minutes to obtain results as opposed to 10 minutes for the SmokeScreen but if tests are conducted prior to questionnaire completion and the oral examination this will not pose a problem.

It was decided that NicAlert was to be used to measure cotinine in this research project

Dental Health Services & Research Unit

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DENTAL HEALTH SERVICES • RESEARCH UNIT •

PHaSCe

Periodontal Health and Smoking Cessation

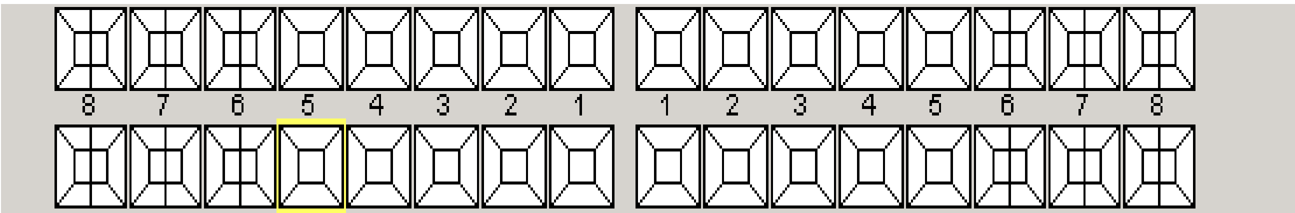
Oral Examination
Version 1.1, 24/05/10

Examination

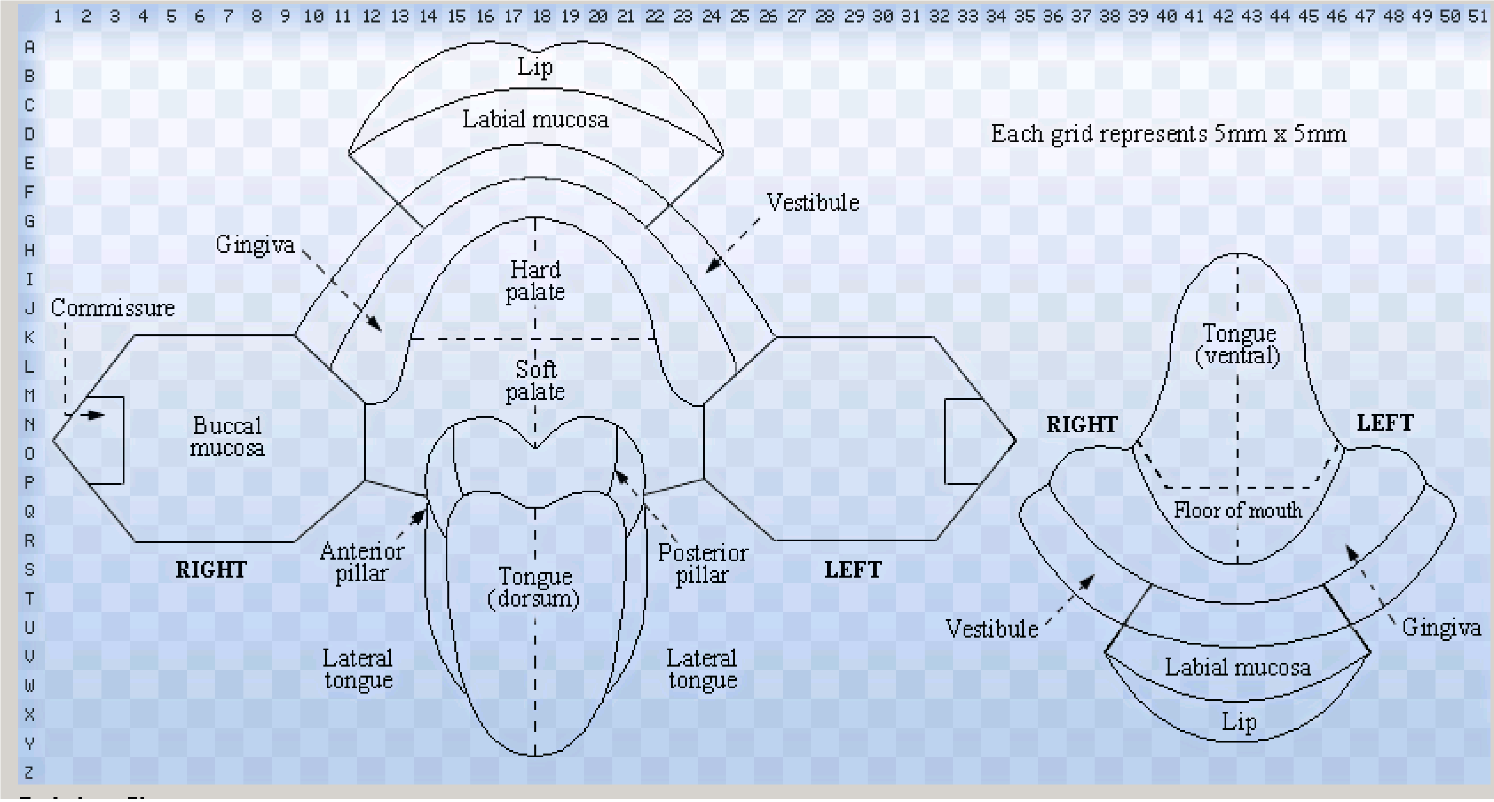
Extraoral examination	No abnormality	Abnormality – please describe
Submandibular glands		
Temperomandibular joints		
Facial tissues		
Perioral/lips		

Intraoral examination

Charting

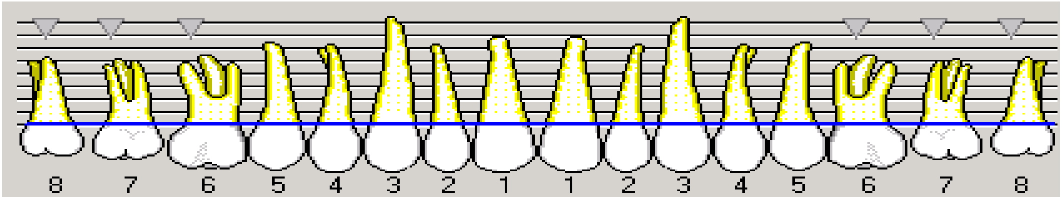


Soft tissue chart



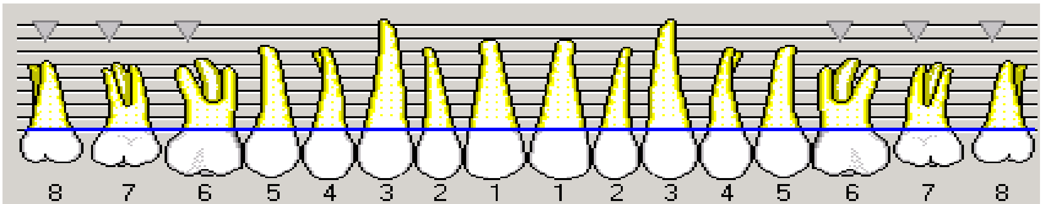
Periodontal Chart

Buccal



	8			7			6			5			4			3			2			1			1			2			3			4			5			6			7			8		
Poc																																																
Rec																																																
AL																																																

Palatal



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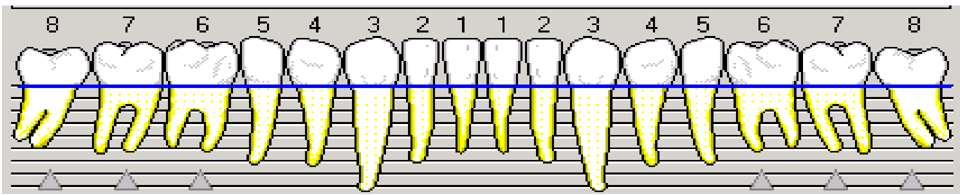
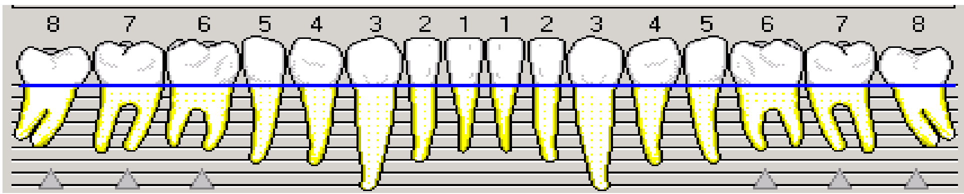
Periodontal Chart

Buccal



	8			7			6			5			4			3			2			1			1			2			3			4			5			6			7			8		
Poc																																																
Rec																																																
AL																																																

Lingual



	8			7			6			5			4			3			2			1			1			2			3			4			5			6			7			8		
Poc																																																
Rec																																																
AL																																																

Plaque and Bleeding Scores

PLAQUE															
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

BLEEDING															
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

PLAQUE AND BLEEDING															
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Periodontal treatment required?

☐ Yes ☐ No

Periodontal treatment appointment arranged?

☐ Yes ☐ No

Appointment for any other necessary treatment arranged?

☐ Yes ☐ No

Samples

Cotinine reading ______________________________

CO reading ______________________________

Agree to participate in smoking cessation intervention?

☐ Yes ☐ No

Initial smoking cessation visit arranged?

☐ Yes ☐ No ☐ Not applicable

Appendix 5: Participant information sheet, Version1.1, 24/05/10

UNIVERSITY OF DUNDEE

Dental Health Services & Research Unit

DENTAL HEALTH SERVICES • RESEARCH UNIT

PARTICIPANT INFORMATION SHEET

PHaSCe

Periodontal Health and Smoking Cessation

We invite you to participate in a research project. We believe it to be of potential importance. However, before you decide whether or not you wish to participate, we need to be sure that you understand first, why we are doing it, and secondly what it would involve if you agreed to participate. Read this information sheet carefully and be sure to ask any questions if you have any. If you like, you may discuss it with others. We will do our best to provide any further information that may ask for now or later. You do not have to make an immediate decision.

My name is Karen Emslie and I am undertaking a PhD at the University of Dundee. I am required to undertake a project as part of my course and invite you to take part in the following study. However, before you decide to do so, I need to be sure that you understand firstly why I am doing it, and secondly what it would involve if you agreed. I am therefore providing you with the following information. Please read it carefully and be sure to ask any questions you might have and, if you want, discuss it with others including your friends and family. I will do my best to explain the project to you with any further information you may ask for now or later.

What is the study about?

Gum disease is found in people all over the world, including here in Mid Argyll, and is a major cause of teeth being lost. Researchers based at the University of Dundee and in Lochgilphead aim to find out how common the problem is in our local population and look at ways we can tackle it. Previous research has shown a link between smoking cigarettes and gum disease and the study will focus on this. Everyone taking part will be offered advice and treatment for any gum disease they have, and then be allocated to one of two groups offering different support to quit smoking. We will use the results to improve the service we provide to patients with gum disease.

Who will take part?

Any adult (over the age of 18) who attends the dental practice based at the Mid Argyll Hospital & Integrated Care Centre and is a smoker is invited to take part.

What would I have to do?

You will have your gums and mouth looked at by a trained dentist or dental therapist. You will also be asked to fill in a questionnaire about what you think about your dental health, how you care for your teeth, if your mouth bothers you or affects your mood, and about your smoking habits. An appointment will be arranged for you to have any treatment and/or advice required to improve your gum health. You will then be allocated to one of two groups. Each group offers participants support to stop smoking but in different ways, and the improvement in the gum health of people in the two groups will be compared at the end of the study.

Smokers in one group will be given brief advice on stopping smoking and referred to smoking cessation services for further advice and support. In the other group intensive smoking cessation support will be provided by the dental team. This would involve 4 – 6 visits to support you in trying to stop smoking and nicotine replacement therapy will be offered to anyone who would like to try it.

In both groups a sample of your saliva will be taken to help measure the amount of nicotine in your body. You will also be asked to blow into a device which measures the carbon monoxide in your breath as this also indicates if you have smoked recently. All participants will be contacted one month and three months after they enter the study to ask if they are still smoking. This may be done at a regular appointment or by telephone. After six months, participants in both groups will have the mouth examination, saliva and breath tests, and questionnaires repeated to see if your gum health has improved.

NHS Highland operates a scheme whereby people referred for specialist treatment may receive help with their travel costs. If you would like to enquire about this please call 01546 604989 for more information.

Will everyone be asked to do the same things?

Everyone will have their mouths looked at in same way, and receive the treatment and advice they need, but the support to stop smoking offered to the two groups of participants will be different.

Will what I say be confidential?

Yes, all the information about your dental health and smoking habits and everything you say will be confidential. What you say will not be passed on to family members or anyone else. However, during the study it will be necessary for the research team to check the information gathered so that the research is performed to the highest possible standard. With your permission, we will inform your GP of your participation in this study.

Do I have to take part?

No. It is up to you. If you agree you will sign a consent form showing that you understand what is involved and that you have agreed to take part.

Can I change my mind and withdraw at any time?

Yes. You can withdraw at any time you like without giving a reason and your care from dental staff will not be affected.

What's in it for me?

We cannot promise the research will help you personally but it may help to improve the way dental services tackle gum diseases. If you are a smoker who wants to quit, then it offers support in trying to do so.

How do I find out more about the study?

Ask dental staff at the Mid Argyll and they will pass your questions to the research team, or call Karen Emslie on 01546 604989.

Will I find out more about the study?

When the research is finished a report will be available to anyone interested. Ask dental staff for the report if you would like one.

What if there is a problem?

If you believe you have been harmed in any way by taking part in this study, you have the right to pursue a complaint and seek compensation from the University of Dundee who are acting as the research sponsor. Details of this are available from the research team.

Also as a patient of the NHS you have a right to pursue a complaint through the usual NHS process. To do so you can submit a complaint to the:

Complaints Team, NHS Highland, PO Box 57123, Inverness IV1 9AQ

Please note that the NHS has no legal liability for non-negligent harm. However, if you are harmed and this is due to someone's negligence, you may have grounds for a legal action against NHS Highland but you may have to pay legal costs.

Who has reviewed this study?

The Fife & Forth Valley Research Ethics Committee, which has responsibility for scrutinising proposals for medical research on humans, has examined this proposal and has raised no objections from the point of view of medical ethics. It is a requirement that your records in this research be made available for scrutiny by monitors from NHS Highland and the University of Dundee, whose role it is to check that research is properly conducted and the interests of those taking part are adequately protected.

Thank you for taking the time to read this information sheet and for considering taking part in this study.

Karen Emslie, Senior Dental Officer, Researcher, Lochgilphead

Ruth Freeman, Professor of Dental Public Health Research, Dental Health Services & Research Unit, University of Dundee

Andrew Hall, Honorary Consultant in Restorative Dentistry, Dundee Dental Hospital and School, University of Dundee

John Herrick, Clinical Dental Director, Argyll & Bute CHP, NHS Highland

Appendix 6: Consent form, Version 1.3, 07/09/10

PHaSCe

Periodontal Health and Smoking Cessation

WRITTEN CONSENT FORM: Periodontal Health and Smoking Cessation

Participant number: ☐☐☐☐☐

PLEASE INITIAL ALL BOXES AND SIGN YOUR NAME TO CONFIRM THAT:

I have read and understand the information sheet Version 1.3, 07/09/10:
Please initial box ☐

The researcher has explained to me what is involved in the study:
Please initial box ☐

I have had the chance to ask questions about the study:
Please initial box ☐

I understand that my teeth, gums and mouth will be examined:
Please initial box ☐

I understand that I will be asked to provide a sample of saliva and breathe into a measuring device:
Please initial box ☐

I understand that I can withdraw from the study at any time and for any reason and that this will not affect the care I receive from dental staff:
Please initial box ☐

I understand that the research records in this study will be made available to monitors from NHS Highland and the University of Dundee:
Please initial box ☐

I agree to my GP being informed of my participation in this study:
Please initial box ☐

I agree to take part in the study:
Please initial box ☐

Name of participant: ______________________________

Signature of participant: __________________________ Date: ________
(please note that participants must date their own signature)
Name of researcher: ______________________________

Appendix 7

PROTOCOL FOR THE SUPPLY OF NICOTINE REPLACEMENT THERAPY PRODUCTS

Clinical indication to which this Direction applies	
Definition of situation/condition	As an aid to treating tobacco dependence in clients participating in a research project among registered adult dental patients who attend the dental department of the Mid Argyll Community Hospital and Integrated Care Centre (MACHICC). Clients should be motivated, and be prepared to set a quit date and to attend regularly for review and support.
Research protocol criteria for inclusion	Aged 18 years or over Registered dental patients at MACHICC Dentate Capable of giving informed consent to participate Want to participate
Research protocol criteria for exclusion	Receiving stop smoking support elsewhere Diabetic patient Fulminating immune deficiency illness patient Terminally ill Taking medication known to affect periodontal health. Pregnant or breastfeeding
NRT- related Clinical criteria for inclusion	Tobacco users aged 18 years and over identified as sufficiently dependent and motivated to quit. Extremely motivated clients requiring combination NRT therapy to sustain their quit attempts. Extremely motivated clients requiring intermittent type NRT for up to 6 months to sustain a quit attempt, in keeping with individual product licence
NRT – related Clinical criteria for exclusion	Myocardial infarction (MI) or cerebrovascular accident (CVA) within the past 4 weeks Unstable cardiac condition for which client is attending a clinician or is awaiting cardiac investigations Severe cardiac dysrhythmia Moderate to severe hepatic impairment Moderate to severe renal impairment Clients on clozapine presenting with unstable mental health. Clients who are pregnant or breastfeeding as they are excluded form this research project and will be referred to a specialist stop smoking midwife.

NRT – related non – clinical criteria for exclusion	Tobacco users not sufficiently motivated to quit Clients less than 12 years old Clients who have received NRT, varenicline or bupropion as part of a quit attempt supported by an NHS Highland organised stop smoking service within the previous six months, save in exceptional circumstances. Clients who have twice in the last twelve months received NRT, varenicline or bupropion as part of a quit attempt supported by an NHS Highland organised stop smoking service, save in the most exceptional circumstances e.g. hospitalisation for serious illness. *In this context 'an NHS Highland organised stop smoking service' includes quit attempts through the NHS Highland Stop Smoking Service, the Community Pharmacy Stop Smoking Service, or the client's general practice.*
Action if excluded from treatment for clinical reasons	The client will be withdrawn from the research project and an appointment arranged for them to attend NHS Highland Specialist Stop Smoking Services, a specialist stop smoking midwife or their general medical practitioner.
Characteristics of staff authorised to take responsibility for the supply or administration of medicines under this Protocol	
Qualifications	The practitioner has undergone an NHS Highland approved training course in motivational support for stopping smoking i.e. Glasgow Caledonian University smoking cessation accredited course. The practitioner, a dental therapist, belongs to one of the groups authorised to apply a PGD as described in NHS HDL (2001)7 and is currently registered with the General Dental Council, Registration Number: 1032
Additional requirements, specialist qualifications, training, experience and competence necessary	The practitioner will apply her stop smoking skills regularly, ensure she keeps up to date with the best practice in the field of smoking cessation, and record her participation in relevant educational activities her continuing professional development portfolio. This portfolio will be reviewed at least annually with the Argyll & Bute CHP Lead Smoking Cessation Adviser.

<table>
<tr><th colspan="2">Description of treatments available under this Protocol</th></tr>
<tr><td>Name of medicine
Pharmaceutical form & strength
Legal status</td><td>Nicotine in the form of

<u>Patches</u>

16 hour patch: 5mg, 10mg, 15mg and 25mg
24 hour patch: 7mg, 14mg and 21mg
It is recommended that high dose patches be provided for the first 6-8 weeks post-quit, medium dose for the following 2 weeks and low dose for a further 2 weeks

<u>Inhalator</u>

inhalator: 10mg/cartridge
It is recommended that it is used whenever a craving occurs up to a maximum of 12 cartridges /day. Cut down after 6-12 weeks.

<u>Nasal spray</u>

nasal spray: 500 micrograms/metered spray, 1 dose = 2 sprays
It is recommended that for the first 8 weeks use one spray in each nostril up to twice every hour for 16 hours – maximum 64 sprays/day. Cut down to one spray in only one nostril after 8 weeks

<u>Gum</u>

gum: 2mg and 4mg
It is recommended that if smoke <20 cigarettes/day use 2mg gum, and if smoke 20 or more use 4mg gum (can also use 4mg gum if find need more than 15 pieces 2mg/day). Maximum dose 15 pieces of 4mg gum/day. Try to cut down after 12 weeks.

<u>Lozenges</u>

lozenges: 1mg, 1.5mg, 2mg, 4mg
It is recommended that if smoke < 20 cigarettes/day use low strength lozenges and higher strength if smoke 20 or more. One lozenge to be taken every 1-2 hours. Maximum 15 lozenges/day. Cut down after 6-12 weeks.

<u>Sublingual tablets</u>

sublingual tablet: 2mg
It is recommended that if smoke < 20 cigarettes/day use one tablet every hour, 2 tablets every hour if smoke 20 or more. Maximum 40/day. Cut down after 12 weeks.

All NRT products within this Protocol are General Sales List items</td></tr>
<tr><td>Dose
Route/method of administration
Frequency of dose</td><td>In accordance with each client's needs and the instructions in the most recent British National Formulary.</td></tr>
</table>

Duration of treatment Follow up treatment	• <u>Routinely</u>: Up to 12 weeks supply of NRT. NRT will be supplied on a weekly basis for the first four weeks. For sessions 6 to 13 (quit weeks 4 – 11) clients may be given 1 or 2 weeks supply at the discretion of the adviser (Annex 1) • <u>Exceptionally</u>: Some extremely motivated highly dependent clients require therapy for longer than 12 weeks to sustain a quit attempt. This protocol allows these clients to receive intermittent types of NRT for a further 3 month period in accordance with the individual product licence, up to an overall maximum of 25 weeks NRT supply per quit attempt. It is essential that these clients are re-assessed weekly and after the initial twelve weeks are only given 1 week's supply at a time (Annex 1). Some highly motivated clients who have demonstrated their commitment to their quit attempts will experience extreme withdrawal symptoms which are assessed as having a high probability of causing relapse. These clients will need a combination of NRT therapies (i.e. patch + an intermittent type NRT) in order to sustain their attempts. Such combination therapy will be provided in the first three months of their quit attempts for periods depending on each client's assessed need. A condition of combination therapy is that clients attend weekly for review and specialist support.
Advice to be given to client	Specific advice on use of their chosen NRT product as per latest version of the BNF General advice on: Side-effects, emphasising that these are usually transient Withdrawal symptoms Possible changes in metabolic rate e.g. weight gain, and how to manage this Avoid smoking while using NRT to avoid the risks of excess nicotine dose Give product information and self-help leaflets How to access further supply of NRT
Consent	The practitioner must ensure that the client reads and signs the Client Information Record (Appendix 5) which indicates consent to treatment. *Separate consent to participation in the research project will have been obtained by the researcher prior to their appointment with the dental therapist.*
Identifying and managing possible adverse reactions	The practitioner using this protocol must check the client's medical history at each visit to ensure that they are suitable for receipt of NRT. **General side-effects from NRT:** These are mostly transient. More common side-effects are: • Gastro-intestinal disturbances (including nausea, vomiting, dyspepsia) • Headache • Dizziness • Influenza-like symptoms

- Dry mouth
- Rash

Less frequently:

- Palpitation

Rarely:

- Atrial fibrillation

Nasal spray:

Sneezing
Epistaxis
Watering eyes
Ear sensations

Lozenges:

Thirst
Parasthesia of mouth
Taste disturbance

Patches:

Skin reactions
Vasculitis
Blood pressure changes

Patches or lozenges:

Sleep disturbances
Nightmares
Chest pain

Gum or lozenges:

Mouth ulceration
Increased salivation

Gum, lozenges, sublingual lozenges, inhalator:

Hiccups
Throat irritation

Other side-effects:
Some of the above listed effects may also be a consequence of stopping smoking rather than NRT use. Others include cold-like symptoms, insomnia, vivid dreams, myalgia, anxiety, irritability, sleepiness, poor concentration, dysmenorrhoea, jaw pain.

Management of specific reactions
Skin reactions when using patches:
This may be due to hypersensitivity to the adhesive and changing to another brand nay help. Otherwise client should be changed to another form of NRT.

Gastrointestinal upset, jaw pain or hiccups when using gum or lozenges:
This is due to a high proportion of the nicotine being swallowed because of poor technique. Reinforce advice on technique or change to an alternative NRT product.

Nasal irritation, sneezing, watering eyes and throat irritation when using the nasal spray:

	This usually declines after the first few days of treatment. Clients should be advised to use caution when driving or operating machinery if affected. **If it is felt that NRT has influenced the effects of other medication, refer client to their GMP**
Facilities and supplies	Provision has been made for the safe storage of NRT products in a locked cupboard within the dental surgery. The following labels will be affixed to the NRT product(s) provided to the clients: Follow the instructions for use detailed on the information leaflet within the container. Client's name:………………………….. Date: __/__/__ Periodontal Health & Smoking Cessation Project Mid Argyll CHICC Blarbuie Road Lochgilphead PA31 8LB Tel: 07917 040253 <u>KEEP OUT OF REACH OF CHILDREN</u>
Details of treatment records required	The outcome of every consultation and details of any NRT supplied must be entered in the Client Information Record (see Appendix 5). If the practitioner does not feel they have sufficient information to complete the Client Information Record then they should seek the information required from the client's general medical practitioner or other source before proceeding to supply NRT.

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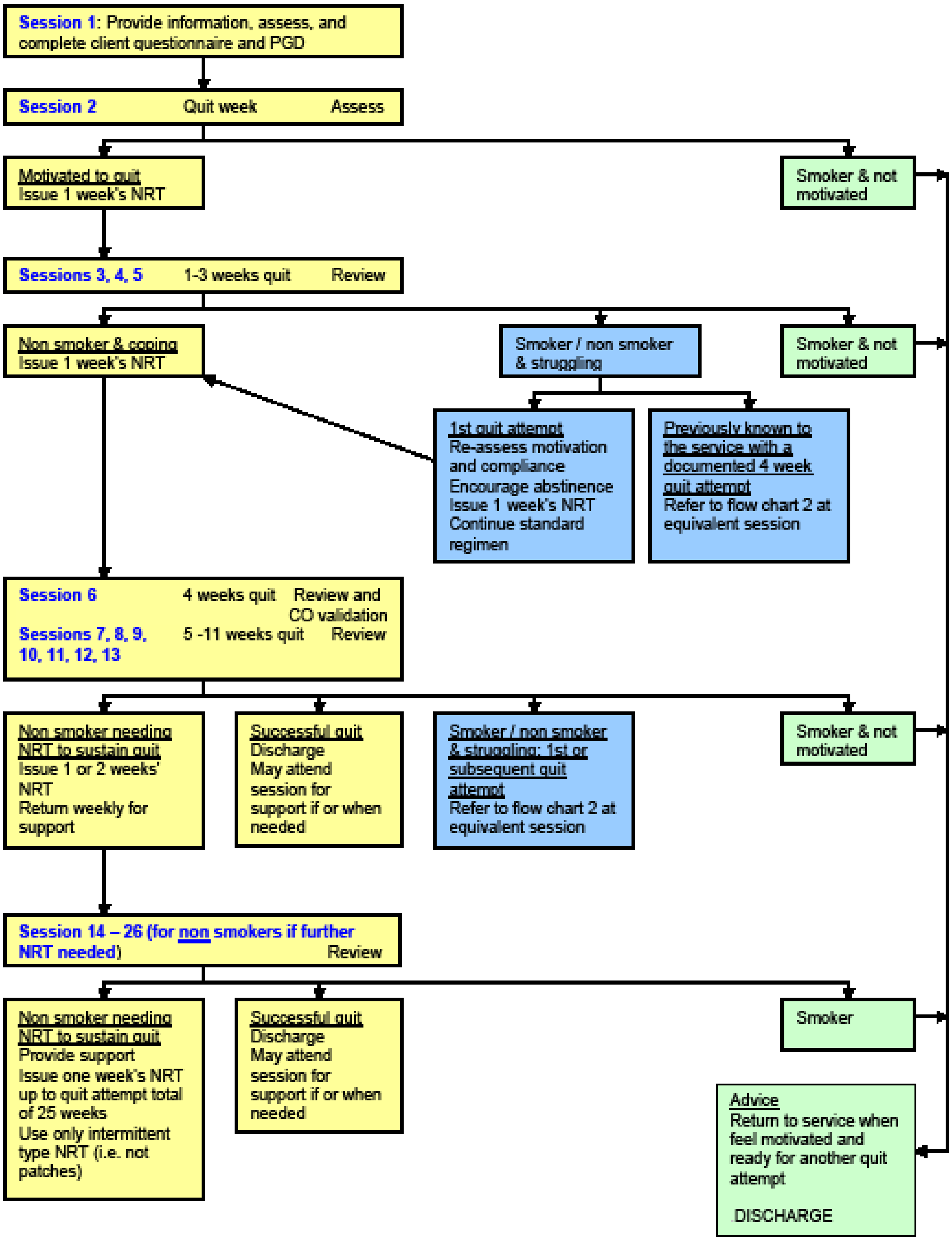
Annex 1

Flow Chart 1: Routine quit and quit extending beyond 12 weeks

NHS Highland



Appendix 8: Scottish Government Minimum Dataset

HIGHLAND SMOKING CESSATION RECORD
CLIENT INFORMATION RECORD

NHS Highland

CHI number .... Clinic Location ....

CHP ....

Advisor's Name .... Advisor's Tel No ....

Title .... Client Name ....

Address ....

.... Post code ....

Tel No (home) .... Mobile ....

DOB

Gender Male ❑ Female❑

Pregnant at quit date? Yes❑ No❑

Ethnic Origin

A. Asian, Asian Scottish or Asian British	B. Mixed	C. Chinese	D. . Black, Black Scottish or Black British	E. White
❑Indian ❑Pakistani ❑Bangladeshi ❑Any other Asian background *please specify:*	❑White & Black Caribbean ❑White & Black African ❑Any other mixed background *please specify:*	❑	❑Caribbean ❑African ❑Any other Black background *please specify:*	❑Scottish ❑Other British ❑Irish ❑Any other white background *please specify:*

Any other background:

Employment Status

In paid employment ❑ Full time student ❑ Unemployed ❑ Homemaker/full time parent ❑

Retired ❑ Permanently sick or disabled ❑ Not known/missing information ❑

Other (please specify) ....

Tobacco Use

How soon after you wake up do you smoke your first cigarette?

Less than 5 mins ❑ 6-30 mins ❑ 31-60 mins ❑ over 60 mins ❑ Unknown❑

How many cigarettes do you smoke per day?

10 or less ❑ 11-20 ❑ 21-30 ❑ over 30 ❑ Unknown❑

How easy or difficult would you find it to go without smoking for a whole day?

Very easy ❑ Fairly easy ❑ Fairly difficult ❑ Very difficult ❑ Unknown❑

Any quit attempts in the last year? None ❑ 1 ❑ 2 or 3 ❑ 4 or more ❑ Unknown ❑

Quit Date Tick here if contact ended without setting quit date ❑

Consent

The Highland Smoking Cessation Service has been fully explained to me. I am aware that details from this form will be passed on to my GP and NHS Highland. Anonymised data will contribute to national monitoring of smoking cessation activity. I may be contacted within the next 12 months to answer questions about quitting smoking and the service I have received while quitting.

I agree to be contacted in future in connection with my smoking (at 1, 3 and 12 months after quitting) ❑

I agree to my doctor being contacted regarding my treatment and progress with giving up smoking ❑

Client's signature ………………………… Date: …………

Follow Up Information

1 Month follow up

Was the client contacted for 1 month follow-up? Yes❑ – Date information collected:

No Lost to follow-up❑ no consent to follow-up ❑ Died ❑

Has the client smoked at all (even a puff) in the last 2 weeks?

Yes❑ Date of last cigarette: No❑ (please conduct 3 and 12 month follow-up) Not known❑

Does carbon monoxide reading confirm quit?

Yes❑ ________ ppm No❑ Not taken ❑ Unknown ❑

Interventions used in this quit attempt:

Group support❑ Pharmacy scheme including support❑ Relapse prevention❑

One to one sessions❑ Buddy Scheme❑ Couple/family based support❑

Both group and one to one sessions❑ Telephone Support❑ Not known/missing info❑

Other (please specify) ________

Pharmaceutical Usage

NRT only ❑ Bupropion ❑ Varenicline❑ Both NRT and Bupropion ❑ Neither ❑ Unknown ❑

Date	Smoking Status	CO Reading	**Assessment**
Signature			
			Visit 1
Signature			
			Visit 2
Signature			
			Visit 3
Signature			
			Visit 4
Signature			
			Visit
Signature			

Key ***S** = Smoker* ***HAP=** had a Puff* ***NS** = Non smoker*

Appendix 9: East of Scotland Research Ethics Committee Decision

NHS Fife NHS Forth Valley NHS Tayside

East of Scotland Research Ethics Service

Fife & Forth Valley Research Ethics Committee
Research Ethics Office
TAHSC, Residency Block C
Ninewells Hospital & Medical School
DUNDEE
DD1 9SY

Ms Karen Emslie
Senior Dental Officer
Dental Office, Aros
Blarbuie Road
LOCHGILPHEAD
PA31 8LB

Date:	02 September 2010
Your Ref:	
Our Ref:	FB/LR/**10/S0501/37**
Enquiries to:	Miss Fiona Bain
Extension:	Ninewells extension 32701
Direct Line:	01382 632701
Email:	fionabain@nhs.net

Dear Ms Emslie

Study Title: **An investigation of the benefit provided by brief and intensive smoking cessation interventions in promoting periodontal health in a population of smokers who regularly attend a general dental practice in a remote and rural area of Scotland.**

REC reference number: **10/S0501/37**

Protocol number: **1**

Thank you for your letter of 27 July 2010, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Vice-Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

1. Regarding the Participant Information Sheet:

   Please amend under 'Who has reviewed this study?':

   The Fife & Forth Valley Research Ethics Committee, which has responsibility for scrutinising proposals for medical research on humans, has examined this proposal and has raised no objections from the point of view of medical ethics. It is a requirement that your records in this research be made available to monitors from NHS Highland and the University of Dundee, whose role is to check that research is properly conducted and the interests of those taking part are adequately protected.'

Please submit a revised Consent Form, which should include a version number and full date as a footer and the new date and version number of Participant Information Sheet in Statement 1.

POSITIVE ABOUT DISABLED PEOPLE

Appendix 9: East of Scotland Research Ethics Committee Decision continued

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

The Committee has not yet been notified of the outcome of any site-specific assessment (SSA) for the non-NHS research site(s) taking part in this study. The favourable opinion does not therefore apply to any non-NHS site at present. I will write to you again as soon as one Research Ethics Committee has notified the outcome of a SSA. In the meantime no study procedures should be initiated at non-NHS sites.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where the only involvement of the NHS organisation is as a Participant Identification Centre (PIC), management permission for research is not required but the R&D office should be notified of the study and agree to the organisation's involvement. Guidance on procedures for PICs is available in IRAS. Further advice should be sought from the R&D office where necessary.

Sponsors are not required to notify the Committee of approvals from host organisations.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Investigator CV		04 June 2010
Protocol	1.8	04 June 2010
CV - Professor Ruth Freeman		02 June 2010
REC application		11 June 2010
Covering Letter		07 June 2010
Summary/Synopsis	1.1	04 June 2010
Letter from Sponsor		11 June 2010
Advertisement	Patient Information Leaflet Version 1	24 May 2010
Advertisement	Poster Version 1.1	24 May 2010
Participant Information Sheet	1.2	27 July 2010

Appendix 9: East of Scotland Research Ethics Committee Decision continued

Response to Request for Further Information		27 July 2010
Participant Consent Form	1.2	27 July 2010
Questionnaire: Dental Health and Smoking Habits Form	1.1	24 May 2010
Questionnaire: Oral Examination	1.1	24 May 2010
Questionnaire: One Month Follow Up	1.1	24 May 2010
Questionnaire: Three Month Follow Up	1.1	24 May 2010
Letter from Funder		08 December 2009
Evidence of insurance or indemnity		19 August 2009
Letter from Statistician		08 March 2010

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Service website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

10/S0501/37	**Please quote this number on all correspondence**

Yours sincerely

L. Reilly

for **Ms Cathy Cooke**
Vice-Chair

Enclosures: "After ethical review – guidance for researchers"

Copy to: Dr Anne Langston, TAHSC R&D Department

POSITIVE ABOUT DISABLED PEOPLE

Appendix 10: NHS Highland Research & Development Committee Decision

Mr Angus Watson
Research & Development Director
NHS Highland Research & Development Office
Room S101
Centre for Health Science
Old Perth Road
Inverness
IV2 3JH

Tel: 01463 255822
Fax: 01463 255838
E-mail: angus.watson@nhs.net

NHS Highland

29 September 2010

NHS Highland R&D ID: **684**

Ms Karen Emslie
Senior Dental Officer
Dental Office
Aros
Blarbuie Road
Lochgilphead
PA31 8LB

Dear Ms Emslie,

Management Approval for Non-Commercial Research

I am pleased to tell you that you now have Management Approval for the research project entitled: **'An Investigation of the Benefit Provided by Brief and Intensive Smoking Cessation Interventions in Promoting Peridontal Health in a Population of Smokers Who Regularly Attend a General Dental Practice in a Remote and Rural Area of Scotland.'** I acknowledge that:

- The project is co-sponsored by NHS Tayside and the University of Dundee (Tayside Academic Health Sciences Centre).
- The project does not require external funding.
- Research Ethics approval for the project has been obtained from the East of Scotland Research Ethics Committee, (Reference Number: 10/S0501/37).
- The Site-Specific Information form for this site has been reviewed (completed on 29/09/10) and there is no objection to NHS Highland being included as a site for this project

Working with you to make Highland the healthy place to be

Headquarters:
NHS Highland, Assynt House, Beechwood Park, Inverness, IV2 3HG

Chairman: Mr Garry Coutts
Chief Executive: Dr Roger Gibbins BA MBA PhD
Highland NHS Board is the common name of Highland Health Board

POSITIVE ABOUT DISABLED PEOPLE

Appendix 10: NHS Highland Research & Development Committee Decision

The following conditions apply:

- The responsibility for monitoring and auditing this project lies with NHS Tayside and the University of Dundee (Tayside Academic Health Sciences Centre).
- This study will be subject to ongoing monitoring for Research Governance purposes and may be audited to ensure compliance with the Research Governance Framework for Health and Community Care in Scotland (2006, 2nd Edition), however prior written notice of audit will be given.
- All amendments (minor or substantial) to the protocol or to the REC application should be copied to the NHS Highland Research and Development Office together with a copy of the corresponding approval letter. All such amendments will be covered by the approval given by this letter, and it is therefore not necessary to seek amendment approval.
- The paperwork concerning all incidents, adverse events and serious adverse events, thought to be attributable to participant's involvement in this project should be copied to the NHS Highland R&D Office.

Please report the information detailed above, or any other changes in resources used, or staff involved in the project, to the NHS Highland Research and Development Manager, Frances Hines (01463 255822, frances.hines@nhs.net).

Yours sincerely,

Mr Angus Watson
Research and Development Director

cc Frances Hines, R&D Manager, NHS Highland Research & Development Office, Room S101, The Centre for Health Science, Old Perth Road, Inverness, IV2 3JH

Appendix 11: Exclusion criteria checklist

Study no.			
Author(s)			
Title			
Publication			
		Yes	No
Article presenting original research?			
Study design is cross-sectional population, cohort or randomised controlled trial?			
Study includes a dental component			
Study related to tobacco use prevalence or cessation			
Study included?			

Appendix 12: Initial Analysis of Papers for Inclusion – all databases

	Article	Authors	Journal & Date	Accepted	Exclusion criteria
1.	Evaluation of educational material for tobacco prevention and cessation used in West Virginia University dental programs	Wiener, R.C. & Wiener Pia, R.M.	Journal of Dental Hygiene 2011 Summer 85(3):204-210	Yes	Educational intervention of tobacco prevention materials
2	Tobacco cessation efforts in dentistry: a rural state study	Morgan, S., Gonzalez, E., Hunter, E. & Ha, K.H.	General Dentistry 2011May-Jun 59(3):126-130	Yes	Cross-sectional survey of attitudes and current practice
3.	Self-reported tobacco use, knowledge on tobacco legislation and tobacco hazards among adolescents in rural Kerala State	Jayakrishnan, R., Geetha, S., Binukumar, B. & Lekshmi, K.	Indian Journal of Dental Research 2011 Mar-Apr 22(2):195-199	Yes	Survey of knowledge, attitudes and behaviours
4.	Smokeless tobacco cessation cluster randomized trial with rural high school males: intervention interaction with baseline smoking	Walsh, M.M., Langer, T.J. , Kavanagh, N., Mansell, C., MacDougal, W., Kavanagh, C. & Gansky, S.A.	Nicotine & Tobacco Research. 2010 Jun 12(6):543-550	Yes	RCT – smokeless tobacco cessation intervention
5.	The challenge of delivering oral health services in rural America	Skillman, S.M., Doescher, M.P., Mouradian, W.E. & Brunson, D.K.	Journal of Public Health Dentistry 2010 Jun 70(Suppl 1):49-57	No	Review including smoking cessation. All articles cited assessed for inclusion
6.	An Internet-based abstinence reinforcement smoking cessation intervention in rural smokers	Stoops,W., Dallery, J., Fields, N., Nuzzo, P., Schoenberg, N., Martin, C., Casey, B. & Wong, C.	Drug & Alcohol Dependence. 2009 105(1-2): 56-62	No	No dental component
7.	Periodontitis associated with tobacco smoking among rural Khon Kaen Thai males: analysis of two studies	Chatrchaiwiwatana, S. & Ratanasirii, A.	Journal of the Medical Association of Thailand 2009 Nov 92(11):1524-1531	Yes	Survey – prevalence of periodontitis and smoking
8.	The role of the dental team in preventing and diagnosing cancer: 4. Risk factor reduction: tobacco cessation	Scully, C. & Warnakulasuriya, S.	Dental Update 2005 Sep 32(7):394-396, 399-401	No	Review article. All articles cited assessed for inclusion
9.	Tobacco consumption among adolescents in rural Wardha: where and how tobacco control should focus its attention?	Dongre, A., Deshmukh, P., Murali, N. & Garg, B.	Indian Journal of Cancer 2008 Jul-Sep 45(3):100-106	Yes	Survey – prevalence of tobacco use
10.	Is maternal smoking during early pregnancy a risk factor for all low birth weight infants?	Suzuki, K., Tanaka, T., Kondo, N., Minai. J., Sato, M. & Yamagata, Z.	Journal of Epidemiology 2008 18(3): 89-96	No	Cohort study - no dental component

Appendix 12: Initial Analysis of Papers for Inclusion – all databases continued

	Article	Authors	Journal & Date	Accepted	Exclusion criteria
11.	Variability of healthcare practitioner intervention among 18-24-year-old tobacco users	Zanis, D., Derr, D., Holim, R. & Ibrahim, J.	Journal of Adolescent Health 2008 Jun 42(6):634-636	Yes	Survey – includes dental smoking cessation activity
12.	Prevalence and determinants of tobacco use in a highly literate rural community in southern India	Daniel, A., Nagaraj, K. & Kamath, R.	The National Medical Journal of India 2008 Jul-Aug 21(4):163-165	Yes	Survey – prevalence of tobacco use
13.	Tobacco use, cessation advice to patients and attitudes to tobacco control among physicians in Ukraine	Squier, C., Hesli, V., Lowe, J., Ponamorenko, V. & Medvedovskaya, N.	European Journal of Cancer Prevention 2006 Oct 15(5):458-463	Yes	Survey – healthcare workers knowledge attitudes and behaviours
14.	Characteristics of adolescent smoking in high school students in California	Ellison, J., Mansell, C., Hoika, L., MacDougall, W., Gansky, S. & Walsh, M.	Journal of Dental Hygiene 2006 Spring 80(2):8	Yes	Survey – knowledge attitudes and tobacco use behaviours
15.	A rural school-based oral health program	Jenkins, S. & Geurink, K.	Journal of Dental Hygiene 2006 Jan 80(1):26	Yes	Educational intervention including tobacco cessation
16.	Development and evaluation of a tobacco cessation motivational program for adolescents based on physical attractiveness and oral health	Semer, N., Ellison, J., Mansell, C., Hoika, L., Macdougall, W., Gansky, S. & Walsh, M.	Journal of Dental Hygiene 2005 Fall 79(4):9	Yes	Educational intervention including tobacco cessation
17.	Tobacco, oral cancer, and treatment of dependence	Warnakulasuriya, S., Sutherland,G. & Scully, C.	Oral Oncology 2005 Mar 41(3):244-260	No	Review. All articles cited assessed for inclusion
18.	Bidi smokers at increased risk of oral cancer	Warnakulasuriya, S.	Evidence-Based Dentistry 2005 6(1):19	No	Review. All articles cited assessed for inclusion
19.	Some risk factors for periodontal bone loss in 50-year-old individuals A 10-year cohort study	Paulander, J., Wennstrom, J., Axelsson, P. & Lindhe, J.	Journal of Clinical Periodontology. 2004 31: 489-496	Yes	Cohort study of periodontal risk factors
20.	[A trial of smoking rate survey using the coming-of-age ceremony for evaluating action plans to prevent tobacco use in the young]	Seki, N., Sekijima, K., Tanabe, N. & Suzuki, H.	Japanese Journal of Public Health 2004 Apr 51(4):252-156	Yes	Survey of prevalence of tobacco use
21.	Smoking cessation services provided by dental professionals in a rural Ontario health unit	Brothwell, D. & Armstrong, K.	Journal of the Canadian Dental Association 2004 Feb 70(2):94-98	Yes	Survey – healthcare workers knowledge attitudes and behaviours

Appendix 12: Initial Analysis of Papers for Inclusion – all databases continued

	Article	Authors	Journal & Date	Accepted	Exclusion criteria
22.	Smoking as a risk indicator for periodontal disease in the middle-aged Vietnamese population	Do, G., Spencer, A., Roberts-Thomson, K. & Ha, H.	Community Dentistry & Oral Epidemiology 2003 Dec 31(6):137-446	Yes	Cross-sectional study of periodontal health and smoking
23.	Spit (Smokeless) Tobacco Intervention for High School Athletes: results after 1 year	Walsh, M., Hilton, J., Ellison, J., Gee, L., Chesney, M., Tomar, S. & Ernster, V.	Addictive Behaviors 2003 Aug 28(6):1095-1113	Yes	RCT – smokeless tobacco intervention
24.	Oral screening and brief spit tobacco cessation counseling: a review and findings	Gansky, S., Ellison, J., Kavanagh, C., Hilton, J. & Walsh, M.	Journal of Dental Education 2002 Sep 66(9):1088-1098	Yes	RCT – smokeless tobacco intervention
25.	Spit tobacco cessation counselling: statewide survey of health-care professionals and educators	Prokhorov, A., Wetter, D., Padgett, D., De, M., Le, T. & Kitzman, H.	Substance Use & Misuse 2002 Jan 37(2):171-197	Yes	Survey – healthcare workers knowledge attitudes and behaviours
26.	Tobacco counselling practices of dentists compared to other health care providers in a Midwestern region	Block, D., Block, L., Hutton, S. & Johnson, K.	Journal of Dental Education 1999 Nov 63(11):821-827	Yes	Survey – healthcare workers knowledge attitudes and behaviours
27.	Patient perceptions of tobacco cessation services in dental offices.	Campbell, H., Sletten, M. & Petty T.	Journal of the American Dental Association 1999 Feb 130(2):219-226	Yes	RCT – smoking cessation in dental setting intervention
28.	Assessing the readiness of dentists' offices to adopt tobacco cessation activities	Jennett, P., Henry, S., Campbell, S., Simpson, L. & Husack, J.	Journal of Continuing Education in the Health Professions 1998 Spring 18(2):119-127	Yes	Survey – healthcare workers knowledge attitudes and behaviours
29.	Tobacco education for adolescents in Mississippi. A pilot project	DeMoss, L., Crews, K., Silberman, S., Meydrech, E. & Akin, R.	Mississippi Dental Association Journal 1997 Spring 53(1):21-23	Yes	Pilot educational intervention
30.	Prevalence of smoking among adult American Indian clinic users in northern California	Hodge, F., Cummings, S., Fredericks, L., Kipnis, P., Williams, M.& Teehee, K.	Preventive medicine 1995 Sep 24(5):441-446	Yes	Survey of smoking prevalence
31.	Effect of cessation of tobacco use on the incidence of oral mucosal lesions in a 10-yr follow-up study of 12,212 users	Gupta, P., Murti, P., Bhonsie, R., Mehta, F. & Pindborg, J.	Oral Diseases 1995 Mar 1(1):54-58	Yes	Cohort study - tobacco cessation and oral health

Appendix 12: Initial Analysis of Papers for Inclusion – all databases continued

	Article	Authors	Journal & Date	Accepted	Exclusion criteria
32.	Prevalence, patterns and correlates of spit tobacco in a college athlete population	Walsh, M., Hilton, J., Ernster, V., Masouredis, C. & Grady, D.	Addictive Behaviors 1994 Jul-Aug 19(4):411-427	Yes	Survey of prevalence and current practice
33.	The effect of training on the use of tobacco-use cessation guidelines in dental settings	Walsh, M., Belek, M., Prakash, P., Grimes, B., Heckman, B., Kaufman, N., Meckstroth, R., Kavanagh, C., Murray, J., Weintraub, J., Silverstein, S. & Gansky, S.	Journal of the American Dental Association. 2012 143(6):602-613	Yes	Educational intervention
34.	Challenges in global improvement of oral cancer outcomes: findings from rural Northern India	Dangi, J., Kinnunen, T. & Zavras, A.	Tobacco Induced Diseases. 2012 10(5):1-5	Yes	Cross-sectional screening and survey
35.	Prevalence and prevention of hypertension, diabetes mellitus and coronary artery disease in India	Singh,R., Singh, N., Vajpeyee, S., Alam, S., Tripathi, K., Srivastav, R., Rastogi, S., Goyal, R., Yeolekar, M., Sainanai, G., Shantaram, V., Pella, D., De Meester, F., Basu, T. & Ozimek, L.	World Heart Journal. 2010 3(1):31-43	No	No dental component
36.	Oral Cancer Knowledge among Patients referred to Mashad Dental School, Iran	Pakfetrat, A., Falaki, F., Esmaily, H. & Shabestari, S.	Archives of Iranian Medicine 2010 13(6): 543-548	Yes	Survey of oral health and tobacco knowledge
37.	HIV and smoking in India	Ramesh Kumar, S., Swaminathan, S., Flanigan, T., Mayer, K. & Niaura, R.	Indian Journal of Medical Research. 2009 130:15-22	No	No dental component
38.	Oral health behaviour patterns among Tanzanian university students: a repeat cross-sectional study	Astrom, A. & Masalu, J.	BMC Oral Health. 2001 1(2)	Yes	Cross-sectional study including tobacco use
39.	Toombak use and cigarette smoking in the Sudan: Estimates of prevalence in the Nile State	Idris, A. Ibrahim, Y., Warnakulasuriya, K., Cooper, D., Johnson, N. & Nilsen, R.	Preventive Medicine. 1998 27(4):597-603	Yes	Survey of tobacco use prevalence
40.	A process evaluation of a two-year community cardiovascular risk reduction program: what was done and who knew about it?	Norman, S., Greenberg, R., Marconi, K., Novelli, W., Felix, M., Schechter, C., Stolley, P. & Stunkard, A.	Health Education Research 1990 Mar 5(1):87-97	Yes	Educational intervention partially delivered by dentists
41.	A primary prevention study of oral cancer among Indian villagers. Eight-year follow-up results	Gupta, P., Mehta, F., Pindborg, J., Daftary, D., Aghi, M., Bhonsie, R. & Murti, P.	IARC Scientific Publications 1990 103:149-156	Yes	Cohort study – risk factors for oral cancer
42.	Smokeless Tobacco Cessation Intervention for College Athletes: Results After 1 Year	Walsh, M., Hilton, J., Masouredis, C., Gee, L., Chesney, M. & Ernster, V.	American Journal of Public Health 1999 Feb 89(2): 228-234	Yes	RCT – smokeless tobacco intervention
43.	Cluster-Randomized Controlled Trial of An Athletic Trainer-Directed Spit (Smokeless) Tobacco Intervention for Collegiate Baseball Athletes: Results After 1 Year	Gansky, S., Ellison, J., Rudy, D., Begert, N., Letendre, M., Nelson, L., Kavanagh, C. & Walsh, M.	Journal of Athletic Training 2005 40(2): 76-87	Yes	RCT – smokeless tobacco intervention

Appendix 13: Data extraction checklist

Study no.	
Section 1	
Author(s)	
Title	
Publication	
Dates of data extraction	
Country	
Study design	
Population characteristics	
Care setting	
Exclusion criteria	
Method of randomisation	
Interventions	
Outcomes	
Section 2	
Length of follow-up	
Drop-outs in control and intervention groups	
Continuous or point abstinence	
Verification of abstinence	
Missing data	

Appendix 14: STROBE Checklist

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Appendix 15: CONSORT checklist

CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	
	2b	Specific objectives or hypotheses	
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	
Participants	4a	Eligibility criteria for participants	
	4b	Settings and locations where the data were collected	
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	
	6b	Any changes to trial outcomes after the trial commenced, with reasons	
Sample size	7a	How sample size was determined	
	7b	When applicable, explanation of any interim analyses and stopping guidelines	
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	

Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	
	11b	If relevant, description of the similarity of interventions	
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	
	13b	For each group, losses and exclusions after randomisation, together with reasons	
Recruitment	14a	Dates defining the periods of recruitment and follow-up	
	14b	Why the trial ended or was stopped	
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	
Other information			
Registration	23	Registration number and name of trial registry	
Protocol	24	Where the full trial protocol can be accessed, if available	
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions

Appendix 16: Summary of STROBE checklist data

		Quality assessment				
Article & authors	**Year & location**	**Participant eligibility criteria described**	**Study size & methodology described**	**Potential sources of bias acknowledged**	**Limitations acknowledged**	**Statistical methods described**
Weiner and Weiner [1]	2011 West Virginia, USA	Yes	Yes	No	No	Yes
Morgan et al. [2]	2011 West Virginia, USA	Yes	Yes	Yes	No	No
Jayakrishnan et al. [3]	2011 Kerala, India	Yes	Yes	Yes	Yes	Yes
Chatrchaiwiwatana and Ratanasirii [7]	2009 Khon Kaen, Thailand	Yes	Yes	Yes	No	Yes
Dongre et al. [9]	2008 Wardha, India	Yes	Yes	Yes	No	Yes
Zanis et al. [11]	2008 Pennsylvania, USA	Yes	Yes	No	Yes	Yes
Daniel et al. [12]	2008 India	Yes	Yes	No	Yes	Yes
Squier et al. [13]	2006 Ukraine	Yes	Yes	No	Yes	Yes
Ellison et al. [14]	2006 California, USA	Yes	Yes	Yes	Yes	Yes
Jenkins and Geurink [15]	2006 Texas, USA	Yes	Yes	No	Yes	Yes
Semer et al. [16]	2005 California, USA	Yes	Yes	Yes	Yes	Yes

Appendix 16: Summary of STROBE checklist data continued

		Quality assessment				
Article & authors	**Year & location**	**Participant eligibility criteria described**	**Study size & methodology described**	**Potential sources of bias acknowledged**	**Limitations acknowledged**	**Statistical methods described**
Paulander et al. [19]	2004 Varmland, Sweden	Yes	Yes	Yes	Yes	Yes
Seki et al. [20]	2004 Japan	Yes	Yes	No	No	Yes
Brothwell and Armstrong [21]	2004 Ontario, Canada	Yes	Yes	Yes	Yes	Yes
Do et al. [22]	2003 Vietnam	Yes	Yes	Yes	Yes	Yes
Prokhorov et al.[25]	2002 Texas, USA	Yes	Yes	No	No	No
Block et al. [26]	1999 Midwest, USA	Yes	Yes	No	No	Yes
Jennett et al. [28]	1998 Calgary, Canada	Yes	Yes	No	Yes	Yes
DeMoss et al. [29]	1997 Mississippi, USA	Yes	Yes	Yes	Yes	No
Hodge et al. [30]	1995 California, USA	Yes	Yes	Yes	Yes	Yes
Gupta et al. [31]	1995 Kerala, India	Yes	Yes	No	No	Yes
Walsh et al. [32]	1994 California, USA	Yes	Yes	Yes	Yes	Yes
Walsh et al. [33]	2012 California, USA	Yes	Yes	Yes	Yes	Yes
Dangi et al. [34]	2012 Northern India	Yes	Yes	Yes	Yes	Yes
Pakfetrat et al. [36]	2010 Mashad, Iran	Yes	Yes	No	No	Yes

Appendix 16: Summary of STROBE checklist data continued

		Quality assessment				
Article & authors	**Year & location**	**Participant eligibility criteria described**	**Study size & methodology described**	**Potential sources of bias acknowledged**	**Limitations acknowledged**	**Statistical methods described**
Idris et al. [39]	1998 Nile State, Sudan	Yes	Yes	Yes	Yes	Yes
Norman et al. [40]	1990 Pennsylvania, USA	Yes	Yes	No	Yes	No
Gupta et al. [41]	1995 Kerala, India	Yes	Yes	No	No	Yes

Appendix 17: Summary of CONSORT checklist data

		Walsh et al. 2010 [4]	Walsh et al. 2003 [23]	Gansky et al. 2002 [24]	Walsh et al. 1999 [42]	Gansky et al. 2005 [43]
Title & abstract	1a	Yes	No	No	No	Yes
	1b	Yes	Yes	Yes	Yes	Yes
Introduction	2a	Yes	Yes	Yes	Yes	Yes
	2b	Yes	Yes	Yes	Not specific	Yes
Methods						
Trial design	3a	Yes	Yes	Yes	Yes	Yes
	3b	Yes	Yes	Yes	Yes	Yes
Participants	4a	Yes	Yes	Yes	Yes	Yes
	4b	Yes	Yes	Yes	Yes	Yes
Interventions	5	Yes	Yes	Yes	Yes	Yes
Outcomes	6a	Yes	Yes	Yes	Yes	Yes
	6b	N/A	N/A	N/A	N/A	N/A
Sample size	7a	Yes	Yes	Yes	Yes	Yes
	7b	N/A	N/A	N/A	N/A	N/A
Randomisation						
Sequence generation	8a	No	No	No	No	Yes
	8b	No	No	No	No	Yes
Allocation concealment	9	No	No	No	No	Yes
Implementation	10	No	No	No	No	No
Blinding	11a	Partially	Partially	Partially	Partially	Partially
	11b	N/A	N/A	N/A	N/A	N/A
Statistical methods	12a	Yes	Yes	Yes	Yes	Yes
	12b	Yes	Yes	Yes	Yes	Yes
Results						
Participant flow	13a	Yes – no diagram	Yes – no diagram	Yes – no diagram	Yes – no diagram	Yes – no diagram
	13b	Yes	Yes	Yes	Yes	Yes
Recruitment	14a	Yes	Yes	Yes	Yes	Yes
	14b	N/A	N/A	N/A	N/A	N/A

Appendix 17: Summary of CONSORT checklist data continued

		Walsh et al. 2010 [4]	Walsh et al. 2003 [23]	Gansky et al. 2002 [24]	Walsh et al. 1999 [42]	Gansky et al. 2005 [43]
Baseline data	15	Yes	Yes	Yes	No	Yes
Numbers analysed	16	Yes	Yes	Yes	Yes	Yes
Outcomes and estimation	17a	Yes	Yes	Yes	Yes	Yes
	17b	Yes	Yes	Yes	Yes	Yes
Ancillary analyses	18	Yes	Yes	Yes	Yes	Yes
Harms	19	N/A	N/A	N/A	N/A	N/A
Discussion						
Limitations	20	Yes	Yes	Yes	Yes	Yes
Generalisability	21	Yes	Yes	Yes	Yes	Yes
Interpretation	22	Yes	Yes	Yes	Yes	Yes
Other information						
Registration	23	Yes	No	No	No	No
Protocol	24	No	No	No	No	No
Funding	25	Yes	Yes	Yes	Yes	Yes

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Appendix 18

Table A1: Reported smoking status by reported medical condition

	Reported smoking status				
Reported medical condition	Never smoker n (%)	Ex-smoker n (%)	Current smoker n (%)	X^2 [df]	P
Receiving treatment	54 (29.2)	53 (44.5)	36 (38.7)	7.78 [2]	0.02
Taking medication	93 (50.3)	72 (60.5)	51 (54.8)	3.07 [2]	0.22
Angina	7 (3.8)	8 (6.7)	3 (3.2)	1.93 [2]	0.38
Blood pressure problems	33 (17.8)	31 (26.1)	9 (9.7)	9.40 [2]	0.01
Heart attack	1 (0.5)	8 (6.7)	3 (3.2)	9.46 [2]	0.01
Infectious diseases	0 (0.0)	1 (0.8)	4 (4.3)	9.45 [2]	0.009
Lung diseases	18 (9.7)	11 (9.2)	11 (11.8)	0.43 [2]	0.81
Epilepsy	1 (0.5)	0 (0.0)	2 (2.2)	3.43 [2]	0.18
Diabetes	5 (2.7)	9 (7.6)	3 (3.2)	4.50 [2]	0.11
Blood disorder	12 (6.5)	15 (12.6)	12 (12.9)	4.36 [2]	0.11
Allergies	46 (24.9)	28 (23.5)	14 (15.1)	3.64 [2]	0.16
Pregnant	5 (2.7)	1 (0.8)	2 (2.2)	1.28 [2]	0.53

Appendix 19

Table A2: Number of other smokers in house by age group, gender, occupational group, location and periodontal status

	Number of other smokers in house				X^2 [df]	P
	0 n (%)	1 n (%)	2 n (%)	3 n (%)		
Younger	35 (56.5)	22 (35.5)	3 (4.8)	2 (3.2)	1.44 [3]	0.70
Old	16 (53.3)	13 (43.3)	1 (3.3)	0 (0.0)		
Male	18 (48.6)	16 (43.2)	1 (2.7)	2 (5.4	4.31 [3]	0.23
Female	33 (60.0)	19 (34.4)	3 (5.5)	0 (0.0)		
Occupation 1	21 (63.3)	10 (30.3)	2 (6.1)	0 (0.0)	4.79 [6]	0.57
Occupation 2	15 (60.0)	9 (36.0)	1 (4.0)	0 (0.0)		
Occupation 3	3 (33.3)	5 (55.6)	1 (11.1)	0 (0.0)		
Occupation 4	5 (45.5)	6 (54.5)	0 (0.0)	0 (0.0)		
Lochgilphead	31 (55.4)	23 (41.1)	2 (3.6)	0 (0.0)	3.66 [3]	0.30
Dunoon	20 (55.6)	12 (33.3)	2 (5.6)	2 (5.6)		

Appendix 20: Quit attempts by demography

Table A3: Quit attempts by age group

Quit attempts	Age group		X^2 [df]	P
	Younger (49 years or less) n (%)	Older (50 years or more) n (%)		
Cut down	26 (41.9)	10 (33.3)	0.63 [1]	0.43
Tried to quit	17 (27.4)	5 (16.7)	1.29 [1]	0.26
Quit for at least 24 hours	25 (40.3)	5 (16.7)	5.15 [1]	0.02

Table A4: Quit attempts by gender

Quit attempts	Gender		X^2 [df]	P
	Male n (%)	Female n (%)		
Cut down	13 (35.1)	23 (41.8)	0.42 [1]	0.52
Tried to quit	6 (16.2)	16 (29.1)	2.02 [1]	0.16
Quit for at least 24 hours	10 (27.0)	20 (36.4)	0.88 [1]	0.35

Table A5: Quit attempts by occupational group

Quit attempts	Occupational group				X^2 [df]	P
	1 n (%)	2 n (%)	3 n (%)	4 n (%)		
Cut down	13 (39.4)	9 (36.0)	6 (66.7)	3 (27.3)	3.59 [3]	0.31
Tried to quit	9 (27.3)	6 (24.0)	3 (33.3)	3 (27.3)	0.30 [3]	0.96
Quit for at least 24 hours	11 (33.3)	7 (28.0)	4 (44.4)	4 (36.4)	0.87 [3]	0.83

Table A6: Quit attempts by location

Quit attempts	Location		X^2 [df]	P
	Lochgilphead n (%)	Dunoon n (%)		
Cut down	21 (37.5)	15 (41.7)	0.16 [1]	0.69
Tried to quit	15 (26.8)	7 (19.4)	0.65 [1]	0.42
Quit for at least 24 hours	17 (30.4)	13 (36.1)	0.33 [1]	0.57

Appendix 21: Intention to quit by age group

Table A7: Intention to quit: by age group

Intention to quit	Age group		X^2 [df]	P
	Younger (49 years or less) n (%)	Older (50 years or more) n (%)		
No plans	7 (11.3)	11 (36.7)	9.56 [3]	0.02
Not in next 6 months	13 (21.0)	3 (10.0)		
Intend in next 6 months	38 (61.3)	13 (43.3)		
Have set quit date	4 (6.5)	3 (10.0)		

Appendix 22

Table A8: Attitudes to smoking cessation activities in a dental setting: by age group, gender, occupational group, location and smoking status

	Should dentist ask if smoke?					Should dentist offer smoking advice?				
	Disagree n (%)	Neither/nor n (%)	Agree n (%)	X^2 [df]	P	Disagree n (%)	Neither/nor n (%)	Agree n (%)	X^2 [df]	P
Younger	2 (1.0%)	37 (18.5%)	161 (80.5%)	1.36 [2]	0.51	16 (8.0%)	43 (21.5%)	141 (70.5%)	1.14 [2]	0.57
Older	5 (2.5%)	35 (21.0%)	158 (79.8%)			13 (6.6%)	36 (18.2%)	149 (75.3%)		
Male	4 (2.6%)	25 (16.1%)	126 (81.3%)	1.56 [2]	0.46	13 (8.4%)	24 (15.5%)	118 (76.1%)	3.23 [2]	0.20
Female	3 (1.2%)	47 (19.3%)	193 (79.4%)			16 (6.6%)	55 (22.6%)	172 (70.8%)		
Occupation 1	3 (3.1%)	21 (21.4%)	74 (75.5%)	4.38 [6]	0.63	7 (7.1%)	28 (28.6%)	63 (64.3%)	6.81 [6]	0.34
Occupation 2	1 (1.1%)	15 (17.0%)	72 (81.8%)			7 (8.0%)	21 (23.9%)	60 (68.2%)		
Occupation 3	0 (0%)	17 (17.9%)	78 (82.1%)			6 (6.3%)	16 (16.8%)	73 76.8%)		
Occupation 4	1 (1.9%)	8 (15.4%)	43 (82.7%)			4 (7.7%)	7 (13.5%)	41 (78.8%)		
Lochgilphead	6 (2.0%)	61 (20.3%)	234 (77.7%)	4.51 [2]	0.11	24 (8.0%)	63 (20.9%)	214 (71.1%)	2.06 [2]	0.36
Dunoon	1 (1.0%)	11 (11.3%)	85 (87.6%)			5 (5.2%)	16 (16.5%)	76 (78.4%)		
Never smoker	1 (0.5%)	36 (19.5%)	148 (80.0%)	5.37 [4]	0.25	8 4.3%)	36 (19.5%)	141 (76.2%)	17.29 [4]	<0.001
Ex-smoker	2 (1.7%)	20 (16.8%)	97 (81.5%)			9 (7.6%)	15 (12.6%)	95 (79.8%)		
Smoker	4 (4.3%)	16 (17.2%)	73 (78.5%)			12 (12.9%)	27 (29.0%)	54 (58.1%)		

Table A8: Attitudes to smoking cessation activities in a dental setting: by age group, gender, occupational group, location and smoking status continued

	Should dentist provide counselling?					Should dentist provide NRT?				
	Disagree n (%)	Neither/nor n (%)	Agree n (%)	X^2 [df]	P	Disagree n (%)	Neither/nor n (%)	Agree n (%)	X^2 [df]	P
Younger	23 (11.5%)	51 (25.5%)	126 (63.0%)	1.04 [2]	0.59	16 (8.0%)	58 (29%)	126 (63.0%)	0.94 [2]	0.63
Older	17 (8.6%)	55 (27.8%)	126 (63.6%)			16 (8.1%)	49 (24.7%)	133 (67.2%)		
Male	18 (11.6%)	37 (23.9%)	100 (64.5%)	1.40 [2]	0.50	16 (10.3%)	37 (23.9%)	102 (65.8%)	2.52 [2]	0.28
Female	22 (9.1%)	69 (28.4%)	152 (62.6%)			16 (6.6%)	70 (28.8%)	157 (64.6%)		
Occupation 1	9 (9.2%)	30 (30.6%)	59 (60.2%)	2.94 [6]	0.82	5 (5.1%)	28 (28.6%)	65 (66.3%)	11.13 [6]	0.08
Occupation 2	10 (11.4%)	27 (30.7%)	51 (58.0%)			8 (9.1%)	31 (35.2%)	49 (55.7%)		
Occupation 3	8 (8.4%)	22 (23.2%)	65 (68.4%)			10 (10.5%)	25 (26.3%)	60 (63.2%)		
Occupation 4	6 (11.5%)	13 (25.0%)	33 (63.5%)			2 (3.8%)	8 (15.4%)	42 (80.8%)		
Lochgilphead	30 (10.0%)	87 (28.9%)	184 (61.1%)	3.33 [2]	0.19	23 (7.6%)	83 (27.6%)	195 (64.8%)	0.48 [2]	0.79
Dunoon	10 (10.3%)	19 (19.6%)	68 (70.1%)			9 (9.3%)	24 (24.7%)	64 (66.0%)		
Never smoker	13 (7.0%)	53 (28.6%)	119 (64.3%)	11.13 [4]	0.03	15 (8.1%)	56 (30.3%)	114 (61.6%)	2.42 [4]	0.66
Ex-smoker	13 (10.9%)	22 (18.5%)	84 (70.6%)			9 (7.6%)	27 (22.7%)	83 (69.7%)		
Smoker	14 (15.1%)	30 (32.3%)	49 (52.7%)			8 (8.6%)	24 (25.8%)	61 (65.6%)		

Appendix 23

Table A9: Oral health-related quality of life by location

	Location Mean difference (95% CI)	F [df]	P
OHIP-1	0.23 (0.09 – 0.37)	3.34 [396]	0.001
OHIP-2	0.26 (0.11 – 0.42)	3.35 [396]	0.001
OHIP-3	0.47 (0.24 – 0.71)	3.95 [396]	<0.001
OHIP-4	0.51 (0.28 – 0.75)	4.25 [396]	<0.001
OHIP-5	0.73 (0.45 – 1.02)	5.05 [396]	<0.001
OHIP-6	0.35 (0.10 -0.60)	2.74 [396]	0.006
OHIP-7	0.29 (0.13 – 0.45)	3.62 [396]	<0.001
OHIP-8	0.25 (0.08 – 0.42)	2.88 [396]	0.004
OHIP-9	0.20 (0.00 – 0.39)	1.96 [396]	0.05
OHIP-10	0.62 (0.36 – 0.88)	4.66 [396]	<0.001
OHIP-11	0.27 (0.09 – 0.45)	2.99 [396]	0.003
OHIP-12	0.09 (0.04 – 0.22)	1.37 [396]	0.17
OHIP-13	0.30 (0.11 – 0.49)	3.13 [396]	0.002
OHIP-14	0.16 (0.02 – 0.30)	2.29 [396]	0.02

*The suffixes show the significant differences in OHIP which existed between locations

Appendix 24

Table A10: Complexity of periodontal treatment needs by past experience of smoking cessation activity in a dental setting

	Complexity of periodontal treatment need			X^2 [df]	P
	Complexity 1 n (%)	Complexity 2 n (%)	Complexity 3 n (%)		
Have you been asked if you smoke by your dentist?	27 (65.9)	29 (72.5)	8 (72.7)	0.48 [2]	0.79
Has dentist offered smoking cessation advice?	12 (29.3)	11 (27.5)	3 (27.3)	0.04 [2]	0.98
Dentist offered to refer for smoking cessation?	6 (14.6)	6 (15.0)	3 (27.3)	1.10 [2]	0.58
Dentist given contact details for smoking cessation?	9 (22.0)	5 (12.5)	2 (18.2)	1.26 [2]	0.53

Appendix 25

Table A11: Complexity of periodontal treatment needs reason for last dental attendance

Reason for attendance	Complexity of periodontal treatment needs			X^2 [df]	P
	Complexity 1 n (%)	Complexity 2 n (%)	Complexity 3 n (%)		
Examination	201 (60.7)	18 (37.5)	7 (36.8)	15.40 [4]	0.01
Oral problems	116 (35.0)	26 (54.2)	9 (47.4)		
Other	14 (4.2)	4 (8.3)	3 (15.8)		

Appendix 26

Table A12: Complexity of periodontal treatment needs by use of interdental aids

	Complexity of periodontal treatment needs			X^2 [df]	P
	Complexity 1 n (%)	Complexity 2 n (%)	Complexity 3 n (%)		
Use of interdental aids	174 (52.6)	24 (50.0)	10 (52.6)	0.11 [2]	0.95